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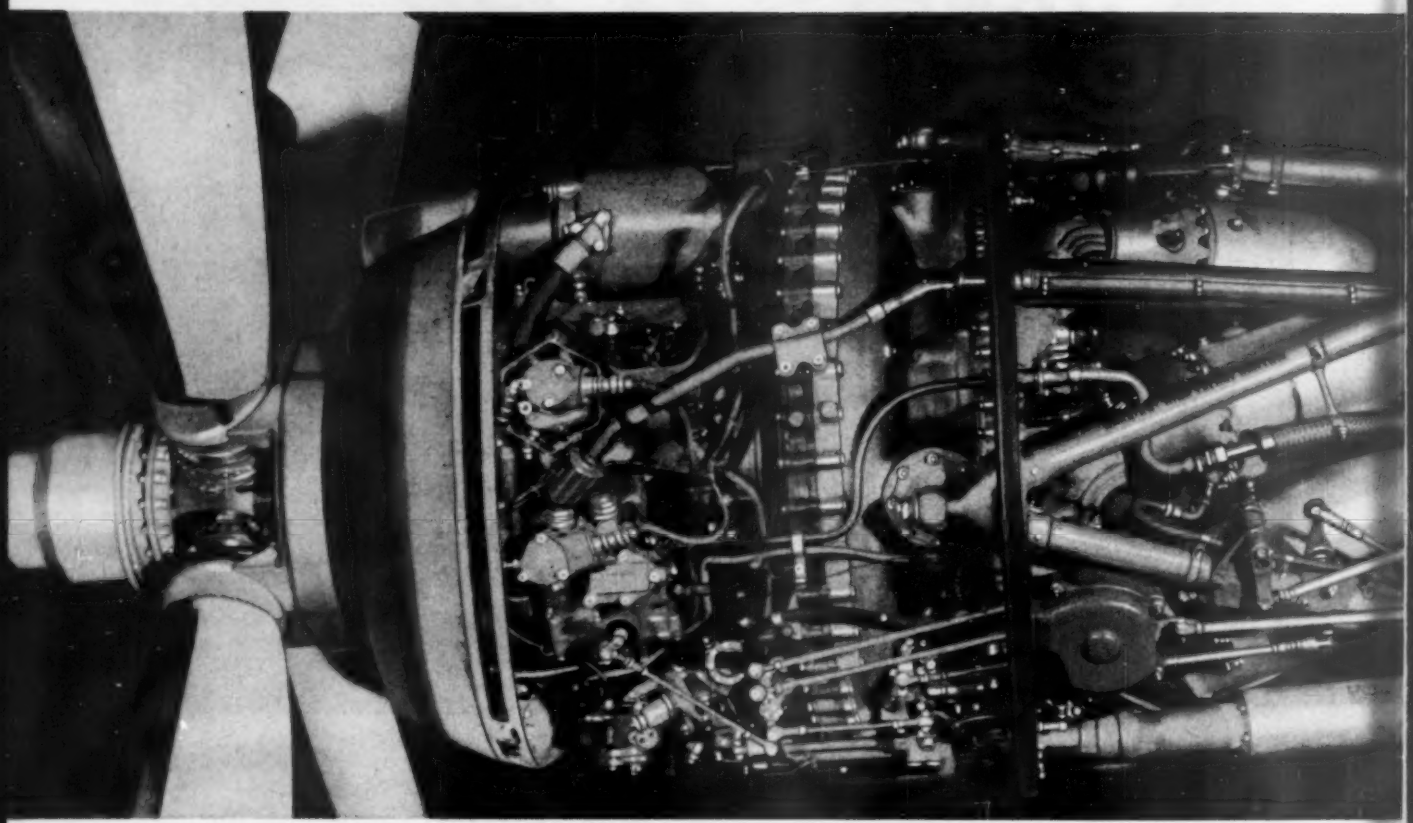

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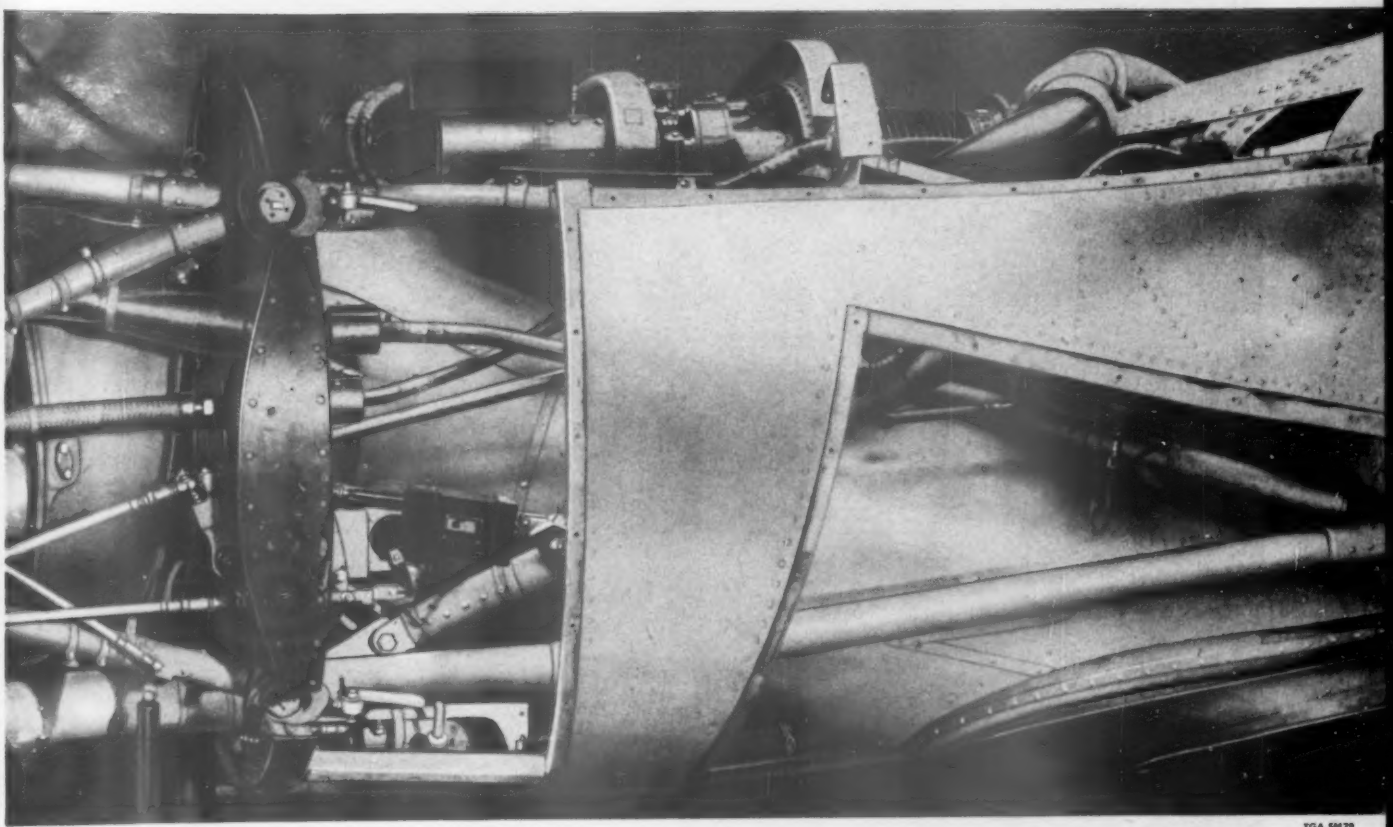

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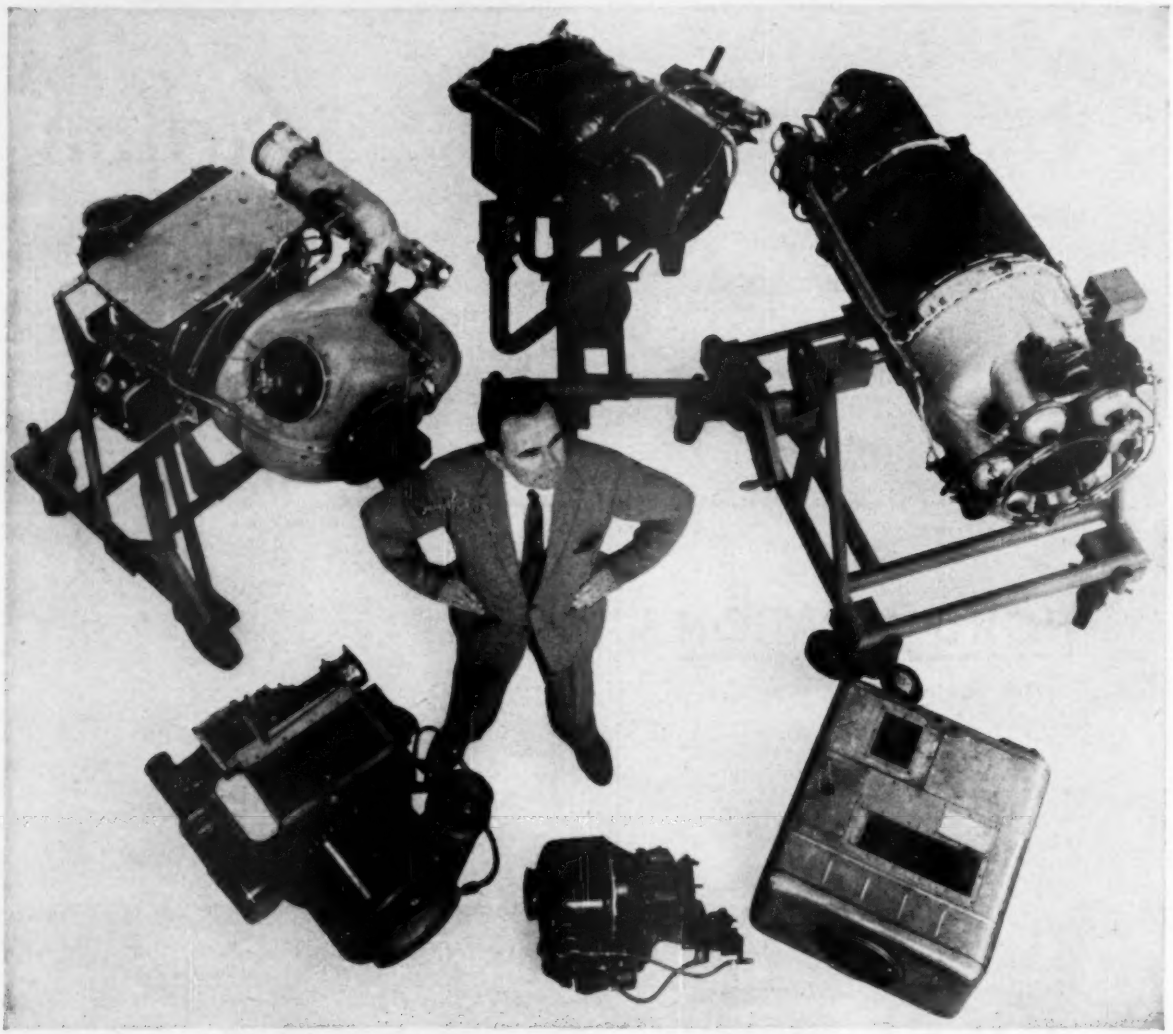

Helmut Schelp, chief engineer, AiResearch Manufacturing Division of Arizona, Phoenix, surrounded by typical gas turbines now in production ranging in size from 30 to 850 hp. Clockwise from the top: GTC 85-28 GTCP 105 • GTP 70-6 • GTP 30-1 • GTP 70-10 • GTU 85-2.

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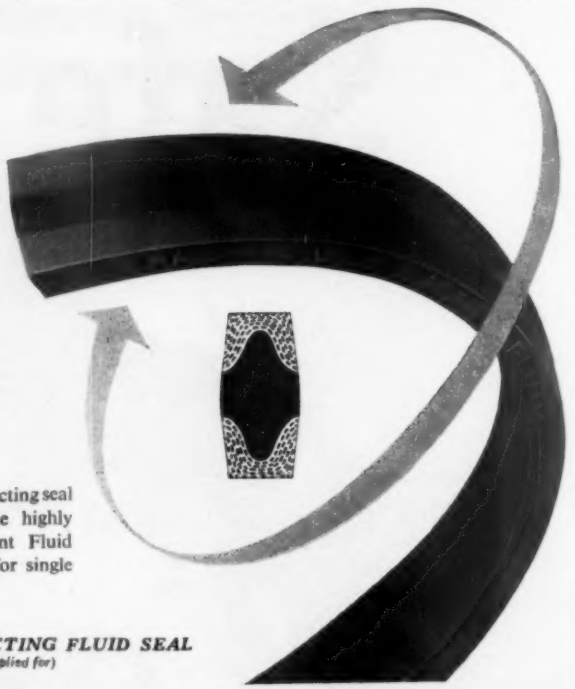

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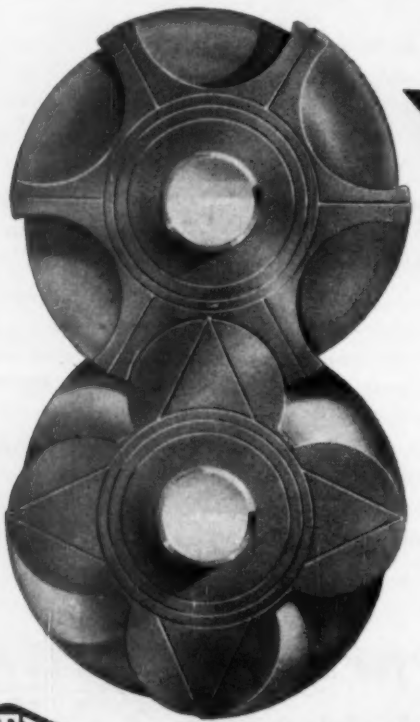

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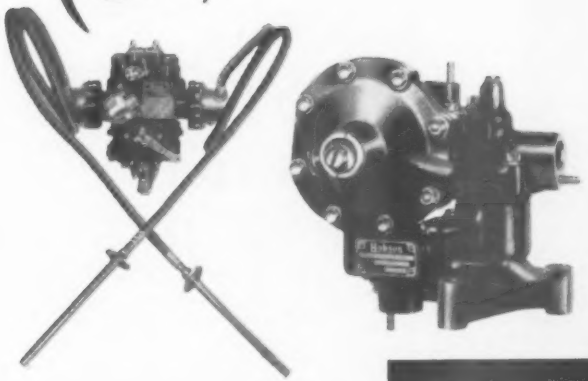

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THE AEROPLANE and ASTRONAUTICS

VOLUME 98 NUMBER 2538 JUNE 10, 1960

What are We Waiting For?

What will one day be honoured as one of the most significant events in the history of British aviation took place at Bedford last week. This was the public demonstration of a fixed-wing aeroplane which is able to rise vertically off the ground with no forward movement while maintaining a horizontal attitude. With no change in that attitude it can be accelerated to a forward speed of between two and three hundred miles an hour. Equally, it can be brought to a standstill in mid air, kept hovering at the pilot's will and then, under full control, lowered gently onto the ground.

Such capability has been the dream of designers and constructors since men started adding wings to balloons. It has been achieved by the conjunction of specially developed lifting engines with a fully automatic and completely integrated stabilization system. The means are now to hand to produce supersonic, or indeed subsonic, airliners capable of commercial operation from launching pads of limited area.

Has anyone dared to think what such developments portend? They mean putting a stop to the seemingly low passage of shatteringly noisy airliners just above the roof-tops. Megamile runways will be obsolete.

Technical details of Short Brothers' great feat, in so far as they are not secret, are discussed at length in the pages of this issue. What we find necessary to recall here is that six years have elapsed since the first stage of this vital development was demonstrated; we refer to the Rolls-Royce Thrust Measuring Rig or Flying Bedstead as it was called by the irreverent. Six years have passed since the demonstration of the first air-jet stabilized lifting turbine combination to that of the fully representative fixed-wing aeroplane taking advantage of lifting units that provide 9 lb. thrust for each 1 lb. of their weight. Rolls-Royce already have units that give 17 lb. of thrust for each 1 lb. of engine weight. Must another six years elapse before the next stage is reached? At least that and more, unless real enthusiasm and drive is conjured up at ministerial level.

How will the picture be affected by intensifying competition? Much work on military VTOL devices has been done in the United States. In this country too there is a promising prototype which has come up by way of a private venture. This is taking shape in the Hawker factory at Kingston. In this design, vertical lift is obtained by ingenious deflection of the efflux of the main jet.

Which of these two competing editions are we going to develop in collaboration with our European partners? It will be remembered that statements associating both France and Germany in such work were made after Mr. Sandys' recent peregrinations. Such collaboration, ideally, could speed the day when VTOL transportation is with us. We certainly do not want to wait until 1970 for it.

Turbine Earnings

Extremely significant figures just issued by the S.B.A.C. show that total engine exports since the War now amount to well over £300,000,000 A remarkable fact is that one-third of this vast total was earned during the past 19 months. These figures do not include earnings from licences. Twenty-three of these, covering thirteen types of engine, have been negotiated with ten countries.

It is worth reflecting on the long, lone struggle waged by that great individualist Sir Frank Whittle, before this wonderful achievement of British industrial effort became possible. The gas turbine had to be developed ahead of any official requirement.

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Editorial, Advertisement and Publishing Offices:
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Telephone: TERminus 3636
Telegrams: "Pressimus London Telex"
Telex: 23839

Annual Subscription Rate: United Kingdom £4 15 0
Overseas £5 Canada and U.S.A. $15.00

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Matters of Moment

Skybolt and the Planners

LAST week the newspapers reported the completion or near completion of arrangements for the acquisition by the United Kingdom of the American Skybolt missile. It seems that some form of partnership between the two countries is intended as regards development and production.

We were glad to see the article on the subject in the *Evening Standard* of Jne. 2. It was written by their recently appointed Defence Correspondent. As Gp. Capt. Hugh Dundas he was well known in the Royal Air Force. After he resigned to join the *Daily Express* he has been increasingly well known as a journalist. He was concerned to point out, as we have so often exerted ourselves to do, that if a country buys weapons it thereby surrenders its authority into the hands of others. How many empires does history record whose downfall can be traced to their failure to provide their own troops and to employ others to do their fighting for them? Today a country's first weapon is its scientific and technical competence.

One subject he did not discuss, and as we have so often made the points he is at pains to impress upon his readers, it is that subject which seems worth concentrating upon. The point to be raised is this. By cancelling Blue Streak, by curtailing the development of the Avro stand-off bomb Blue Steel, by changing over from manned aircraft to missiles, the political and military planners employed by this country have deliberately ensured that the United Kingdom will forgo its authority and responsibility. In the course of his article Gp. Capt. Dundas calls for what he describes as Hurricanes and Spitfires of a new generation. There are no designers of a new generation to design them. There is no requirement for manned aircraft in this field. This is why our friends in NATO buy American. This is why the Canadians go buying in the same field. The Royal Australian Air Force may be forced to follow the same road unless they can be persuaded of the merits of Anglo-French collaboration.

Having decided to go over to missiles we phase out manned fighters and eventually bombers. The country starts to build up missile production and design teams to develop the weapons. Before their work has had time to flower it is cancelled. By the time Skybolt is planned to become operational in the Royal Air Force, how many teams experienced in the development of missiles shall we have?

Another aspect of this situation is the responsibility of the Government departments concerned with scientific forecasting, research and development. Nobody will deny that we are employing the largest army of scientific, technological, engineering and administrative civil service personnel in our history. These men and women cannot collectively escape the responsibility for the situation in which we find ourselves.

Operational requirements are defined or specified by the Fighting Services. It is the job of the civil staffs in the Ministries concerned to see that the Services, while framing such requirements, are correctly informed regarding further developments and potentialities. With such information before them the Services then set out their requirements. When these have been agreed as practicable by the civil staffs of the Departments, orders are placed on industry to produce the goods.

In such circumstances if a requirement under development is suddenly assessed as unsuitable a heavy responsibility must lie upon those who agreed the requirement. Equally, if there is such a gap in our plans that we have to go overseas to fill it, it is those charged with forward looking who must bear the responsibility. Today it is fashionable with a weary smile to say something about Parkinson's Law when bureaucratic organizations wax too monstrous. Might we not get a little nearer the facts if we were to recall that adage of practical people: "Too many cooks spoil the broth." No doubt some reduction in the size of the kitchen staff may be expected when fewer meals are likely to be wanted.

Now that decisions have been taken to call for fewer aeroplanes and to forgo all missile developments except in very limited fields, it will be strange indeed if the country can afford to maintain planning staffs for requirements that will never be called for.

Mr. Sandys in Italy

EARLIER this week Mr. Duncan Sandys, the Minister of Aviation, left for Italy, where he is now engaged in discussions with other ministers representing military and civil aviation from the six Common Market countries. These talks are concerned with the Eurocontrol plan for the control of air traffic at high altitudes over Western Europe. The other countries concerned are France, Germany, Italy, Belgium, the Netherlands and Luxembourg.

This meeting, at which a draft convention will be considered, follows many months of preparation by the Eurocontrol Technical Working Group. This group has been responsible for working out the plan for a common upper-airspace A.T.C. system, to be operated eventually, it is hoped, by an international agency. During March the Working Group held a meeting—its 12th—in London and visited the M.o.A. Air Traffic Control Experimental Unit at London Airport.

Before going to Rome for this meeting Mr. Sandys visited the Fiat factory in Turin. He is also to spend four days in Sweden shortly, at the invitation of the Swedish Government.

Military Transports for India

AVRO is offering its Type 758 project to meet an Indian Air Force requirement for a high-wing military transport. Other companies reported to be competing for the Indian order are Lockheed, with a new aircraft, and Fokker with a development of the Friendship. India wants this new aircraft in addition to the military Avro 748s which will be built under licence there. (The military version of the 748, incidentally, is now designated the Avro 757.)

The new requirement is for a rear-loading military transport to be used for air dropping and for carrying vehicles and freight as well as passengers and troops. The Avro 758 has been designed as a high-wing aircraft to meet this need. Its fuselage diameter, 10 ft. 9 in., is 2 ft. greater than on the Avro 757, and the undercarriage is mounted on the fuselage. The wing is basically that of the Series 2 Avro 748, but its two Rolls-Royce Dart R.Da.7 turboprop engines are in under-slung nacelles.

Wing span of the Avro 758 is 97.4 ft. Maximum take-off weight is 43,600 lb. and maximum payload 10,380 lb.

Its stage length with full payload has been given as 650 n.m.

FIRE POWER.—An English Electric Lightning has an armament of two fixed 30-mm. Aden guns and interchangeable packs for two Firestreaks, 48 × 2-in. air-to-air rockets, or two extra Aden guns. Here 2-in. rockets are seen leaving the two glass-fibre packs which are extended from the fuselage immediately before firing.

in ISA+15° C. conditions, with allowances for taxiing and reserve fuel for a 90-min. cruise at 20,000 ft. With the same allowances it will carry a 7,900-lb. payload over a 1,060-n.m. stage distance. Cruising speed is estimated to be 230 kt. T.A.S. at 20,000 ft.

For take-off at 43,600 lb. weight in ISA+15°C. conditions, the estimated distance to 50 ft. is 2,840 ft. and the field length required, 3,850 ft. The landing distance from 50 ft. in ISA conditions is given as 2,330 ft. at 42,000 lb. all-up weight.

Talking About Noise

THE FACT that a meeting was called by Mr. Duncan Sandys on Jne. 1 to discuss the problem of aircraft noise is to be welcomed as showing that increasing public pressure is beginning to have some effect. We understand that the seriousness of the annoyance was stressed. Those present were told that it was incumbent on all concerned with air transport to make a combined effort to tackle the problem.

The aero-engine manufacturers explained the steps they were taking in their current designs to reduce the ratio of noise to power. The airline companies described the operating procedures they were following to restrict noise over built-up areas in the vicinity of airports and suggested ways of making these more effective. The Minister made it clear that, where noise limitations were laid down, they must be adhered to and hoped that all concerned would help him to secure this by voluntary co-operation.

Those attending the meeting included: Mr. Geoffrey Rippon, Parliamentary Secretary, M.o.A.; Mr. E. A. Armstrong, Controller of Aviation Ground Services, M.o.A.; Mr. M. J. Lighthill, Director of R.A.E.; Mr. H. Constant, Director of N.G.T.E.; Mr. R. S. F. Edwards, general manager London Airports; Mr. J. D. Pearson, Rolls-Royce; Sir Arnold Hall, Bristol Siddeley; Sir Aubrey Burke, Hawker Siddeley Group; Sir George Edwards, British Aircraft Corporation; Mr. E. C. Wheeldon, Westland; Mr. E. C. Bowyer, S.B.A.C.; Sir Gerard d'Erlanger and Mr. Basil Smallpeice, B.O.A.C.; Lord Douglas of Kirtleside, B.E.A.; Mr. C. J. Stevens, B.I.A.T.A.; and Mr. W. H. Lyons of Pan American representing the Foreign Airlines Association.

With the sentiments expressed no one will quarrel. But it is idle to suppose that really effective results are to be expected until an international body is formed to tackle the problem. Here is a chance for the Ministry of Aviation to give a lead to the World. The problem is going to get worse until it is tackled internationally.

Improving Environment

"THE Noise Environment Produced by Turbojet and Rocket Engines" was the title of the paper read before the Society of Environmental Engineers on May 25 by Dr. B. L. Clarkson of Southampton University. His talk was devoted to the effect of noise on aircraft and missile structures and equipment rather than to its effect on the populace at large.

Dr. Clarkson surveyed the characteristics of the noise produced by the turbojet and rocket engines and went on to cover testing techniques. He said that in the U.S. military orders for aircraft included an order for two airframes for noise tests; their engines were run continuously until the airframe failed. In this country a less expensive approach was needed and tests could be made only on sections of an airframe.

Actual running of jet or rocket engines was an expensive way of producing noise for test purposes and substitutes such as sirens had been sought. But, according to a U.S. expert, sirens had been responsible for producing "more useless results more rapidly than any other technique known." This has been because they have often been operated at only a single frequency. Realistic results should be obtained with broadband testing. A noise-test siren of this type is being developed at Southampton University to produce random noise. This siren can give a shaped noise spectrum with varying frequency.

Dr. Clarkson's lecture was typical of those read before this new society, which was formed just over a year ago, and now has slightly more than 100 members. Future lectures are planned on the development and testing of small electronic components, on vibration testing and on accelerated climatic tests. In general, the society is devoted to improving the status of environmental research and testing in the engineering field.

The society is seeking new members; anyone who is keen on joining should write to its office at 42 Manchester Street, London, W.1. There are four grades of private membership—fellow, member, associate and student. In addition the society has sponsor members which can be companies, professional organizations or government departments engaged in the environmental testing field.

Back to de Havilland

RECENT speculations concerning the future of the Aircraft Manufacturing Company—formed as a consortium of de Havilland Aircraft, Fairey Aviation and Hunting Aircraft to produce the DH.121—in the light of the industry's reconstitution into two large aircraft groups, have now been answered. It has been proposed that Airco be dissolved and that complete control of the DH.121 turbojet airliner project should revert to the de Havilland concern.

When Airco was formed, de Havilland had a controlling 67½% interest in it, Hunting had a 22½% interest and Fairey, 10%. With de Havilland Aircraft now part of the Hawker Siddeley Group: Hunting part of the British Aircraft Corporation; and Fairey Aviation a component of the Westland Group, it seemed clear that a smooth integration of the whole project as envisaged in the original Airco form would not prove to be very easy. No details of the proposed dissolution had been given at the time of going to press. It has been said, however, that the companies concerned would co-operate so far as was necessary to ensure that the planned programme for B.E.A.'s new short-range jet airliner would not be held up, and that there would be no delay in its production.

DETERRENT IN BEING.—This Atlas ICBM of Strategic Air Command is maintained "combat ready" at Vandenberg AFB in California; its hydrogen warhead is attached and the missile can be launched at 15 minutes notice.

Howard Levy photograph

A Specialist Retires

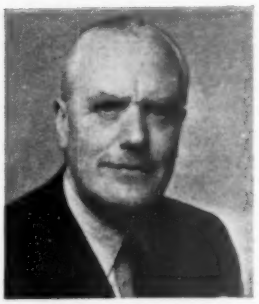
CHIEF engineer of Shell's Aviation Division in London, Mr. E. L. Bass, F.R.Ae.S., M.I.Mech.E., M.I.A.S., F.Inst.Pet., is retiring after 43 years' service with the Royal Dutch/Shell Group of companies. As a mechanical engineer with an exceptionally wide knowledge of internal combustion engines and aeronautical engineering, he has gained international reputation in aviation.

Mr. Bass began his career with the Anglo-Mexican Petroleum Company where he worked on internal combustion engines and marine and stationary diesels. In 1924 he was attached to the laboratory of Harry (now Sir Harry) Ricardo, who was engaged on Shell's behalf in the first studies of knock rating of gasoline. At this time the Ricardo Laboratories were working on the development of the single-sleeve engine both as a compression ignition and gasoline engine, and on the early design and application of the small high-speed compression ignition power-plant. Mr. Bass was also concerned with the original work on ignition rating of diesel fuels and the first use of laboratory engines for the testing of lubricating oils.

In 1932 he took charge of the technical division of Shell's Aviation Department, a position which he has held for 27 years. Between then and the outbreak of war both aircraft engines and fuels were developed intensively. Over this period, fuels from 73 octane unleaded to 100 octane leaded were introduced.

At the outbreak of World War II, Mr. Bass was seconded to the Air Ministry and later to the Ministry of Aircraft Production. From 1941 to 1942 he was attached to the British Air Commission in Washington and concerned with the quality and supplies of fuels and oils from the United States to the R.A.F. On returning to the M.A.P. he was responsible for a research programme by Shell's aero-engine laboratory at Thornton, Cheshire, which included classic work on lead and halogen and mixture distribution, plug fouling and valve burning.

At the end of the War, Mr. Bass returned to Shell's Aviation Department and devoted himself to the development of aviation petroleum products, particularly to work on turbine fuels and problems of icing, combustion performance, etc. Later, he also undertook responsibility for Shell's airfield fuelling equipment at a time when jet aircraft requiring fuelling rates up to 1,000 Imp. gal. per minute were about to be introduced into service.



Mr. E. L. Bass who has retired from the Shell Aviation Division.

Leaving Fairey

AFTER taking an active part in the affairs of the Fairey company for many years, Mr. Richard Fairey has announced that on medical advice he will retire from the board at the end of June. He has been the company's vice-chairman since November, 1956.

Born in November, 1916, Mr. Fairey is the eldest son of the late Sir Richard Fairey and was educated at Harrow. He joined the jig and tool office of his father's company in 1936 and later moved to the design office.

During the War he served with the Air Transport Auxiliary and it was in 1941 that he suffered the great misfortune of having both his legs amputated. He had been on his way by sea to the United States to join the Atlantic Ferry Organization when his ship was torpedoed. He spent five days in an open boat and suffered severely from frost-bite and exposure. When he had recovered and while still convalescent, he joined A. and A.E.E. at Boscombe Down as a technical officer.

After the War, he returned to the Fairey Aviation Company and became works manager of the Weybridge factories. Later he was appointed personal assistant to the assistant managing directors, subsequently becoming general manager. He was elected to the board in 1945.

For many years Mr. Fairey has been an enthusiastic private pilot and has qualified on four-engined aircraft as well as helicopters. In point of fact, he flew solo in a helicopter after only 1 hr. 45 min. of dual instruction and became one of the first operators in this country of an executive helicopter—a Westland Whirlwind which he used for commuting daily from his home in Maidenhead to the factory in Hayes.

Recently, Mr. Fairey completed an extended tour of Fairey's subsidiary companies in Canada and Australia. And during this trip he was responsible for the successful negotiation of a contract with the Indonesian Government for the supply of Gannets to the Indonesian Navy.

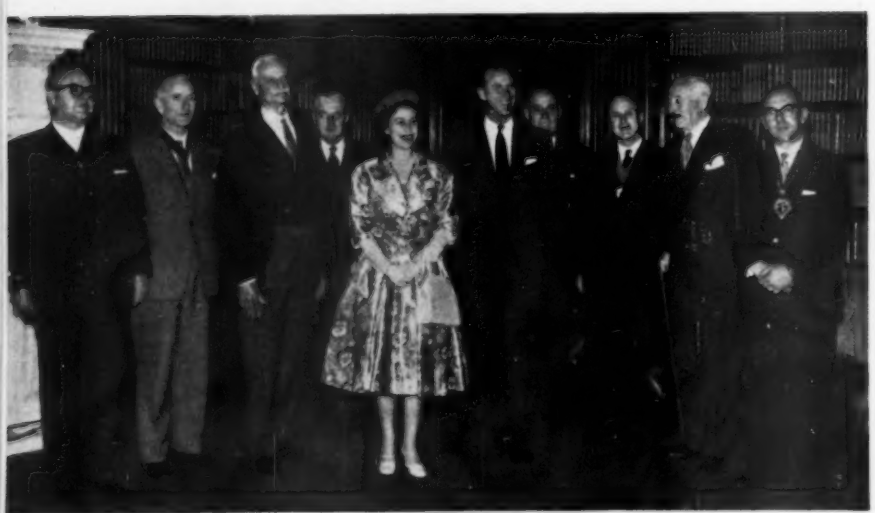
Meeting Her Majesty

NO PARTY is likely to be remembered longer in Fleet Street, and indeed in editorial offices all over the Commonwealth, than that attended by Her Majesty the Queen and H.R.H. the Prince Philip, Duke of Edinburgh, at the home of Lord and Lady Astor of Hever at 18 Carlton House Terrace in London on May 30.

Every guest of the 500 or so present was a journalist from the U.K. or Commonwealth countries and they had been invited to meet Her Majesty, not to attend in a professional capacity. For once then, they were participants in a Royal occasion, not observers of it.

The Queen and the Duke walked among the guests with a minimum of formality. Their progress from group to group was leisurely and the variety of subjects discussed was illustrative of Her Majesty's comprehensive understanding of what interests her subjects. The Duke has a swift wit and his impromptu sallies could be followed by the warm laughter they aroused.

When finally the Royal Party drove away and the guests streamed past their hosts to say "goodbye," many found that they could most truthfully express their feelings by saying, as we did, "that it had been a rare privilege to have been present."—T.J.



When the Queen and the Duke of Edinburgh attended a reception for working journalists of the Commonwealth countries on May 30, given at the home of Lord and Lady Astor of Hever in London, this photograph was taken. With the Royal guests are: (L to R) Mr. Magnus Williamson (president of the National Union of Journalists), Mr. Lewis Simpson (president of the Institute of Journalists), Lord Astor of Hever (president of the Commonwealth Press Union), Mr. Roland E. Dangerfield (chairman, Temple Press Ltd. and president of the Periodical Proprietors' Association), Mr. Alexander Aitken (acting president of the Scottish Daily Newspaper Society), Mr. Roy Pratt Boorman (president of the Newspaper Society), Lord Burnham (deputy chairman of the Newspaper Proprietors' Association), Mr. N. T. Walters (president of the Guild of British Newspaper Editors).

WINNING IN WALES

LAST week-end's opening of the 1960 National Air Races was notable for the success of the first cross-country event to be held for many years. There were 41 starters on Friday, Jne. 3, in the London-Cardiff race, which was won with an easy lead by J. Stewart-Wood in an Auster 5. Poor visibility did not help the contestants, although unusually high speeds were achieved by a following easterly wind of about 10 knots.

An unusually large proportion of women aviators took part in the races, including Janet Ferguson, Joan Short, Margot MacKellar, Miss G. M. Cazalet and Miss S. Scott. The two last-mentioned ladies came fourth and fifth in the cross-country event, and Miss Scott also succeeded in winning, with Geoffrey Marler, the D.H. Tiger Moth Trophy in Class III of Saturday's closed-circuit events. First home in the other two races were Percy Blamire in Class I, for the Air League Cup, and John Severne, in Class II, for the Norton-Griffiths Trophy.

The winners of the three races, however, did not necessarily get the trophies, as these were awarded on aggregate points, which included those earned in the London-Cardiff race. Thus the Air League Cup went to Dennis Hartas, the Norton-Griffiths Trophy to J. Stewart-Wood, and the D.H. Tiger Moth Trophy was shared between Sheila Scott and Geoffrey Marler.

Actual prize money was distributed as follows: AIR LEAGUE CUP RACE: Blamire, Hartas, A. S. K. Paine and A. J. Spiller; NORTON-GRIFFITHS TROPHY RACE: John Severne, C. P. Francis, W. H. Bailey and J. Stewart-Wood; TIGER MOTH TROPHY RACE: Sheila Scott, Beverley Snook, C. A. N. Bishop and L. J. Benjamin.

In the table alongside may be seen the start and finish order for both races, in all three classes, and the speeds in m.p.h. The first seven entrants in each class qualify for the forthcoming King's Cup race.

AIRCRAFT	PILOT	LONDON–CARDIFF			CLOSED CIRCUIT		
		St.	Fin.	Spd.	St.	Fin.	Spd.
Class I (Air League Challenge Cup)							
Hawk Six	R. R. Paine	40	10	205¼	12	*	186¼
Proctor 3	G. P. Watson	35	8	162¾	7	5	145
Cessna 175	R. H. McIntosh	32	2	159¾	6	10	130
Gemini 3C	E. Crabtree	37	24	180	10	6	163½
Chipmunk	P. G. Masefield	34	36	145¾	5	9	127
Proctor 1	A. S. K. Paine	38	15	168¾	9	3	154
Proctor 3	A. J. Spiller	33	19	155¼	4	4	139
Gemini 3C	P. Blamire	39	17	185	11	1	171¼
Linnet	D. W. Phillips	25	29	134¼	2	8	121
Proctor	K. B. Neely	36	22	162¾	8	7	146
Jodel D.117	D. M. Hartas	24	9	135	1	2	122¼
Swift	C. Boddington	27	12	139¼	3	*	127¼
Spitfire 8	V. H. Bellamy	41	30	322	13	11	254
Class II (Norton-Griffiths Challenge Trophy)							
Turbulent	J. Severne	5	7	110¼	6	1	100
Taylorcraft	C. Gregory	17	16	125¼	7	6	111¼
Auster V	J. Stewart-Wood	18	1	134¼	8	4	120¼
Turbulent	J. L. Ferguson	23	†	—	—	—	—
Hawk Tr.	W. H. Bailey	31	28	144¾	13	3	133
Turbulent	C. P. Francis	4	31	105¼	4	2	95
Prentice	G. Rees	29	27	139¼	11	8	126¼
Turbulent	J. H. Short	1	34	97	1	*	84
Turbulent	N. H. Jones	2	35	98¾	2	10	83
Turbulent	M. MacKellar	3	32	103	3	†	—
Wot	J. F. Underwood	6	37	98	5	11	100
Prentice	C. W. Hubbard	30	21	142¾	12	9	126
Auster 6	R. W. Bowles	25	6	141	9	5	126¼
Auster J1/N	J. H. Denyer	28	26	138	10	7	126¼
Autocrat	M. L. Brewer	15	39	99	†	—	—
Class III (D.H. Tiger Moth Challenge Trophy)							
Tiger Moth	C. A. N. Bishop	9	14	116¾	3	3	104¼
Tiger Moth	J. M. Donald	12	†	—	—	—	—
Moth Minor	H. A. G. Smith	16	18	123¾	8	8	112
Hornet Moth	J. Piercy	20	25	128	10	11	114
Tiger Moth	E. D. Fox	12	30	115¼	6	12	102¼
Tiger Moth	L. J. Benjamin	21	23	129	11	4	117¼
Tiger Moth	C. E. Elton	9	13	116¾	3	6	104
Tiger Moth	W. P. Meynell	11	20	117¼	5	9	105
Jackaroo	S. Scott	7	5	115¾	1	1	104
Hornet Moth	J. W. C. Judge	19	33	124¾	9	7	113¼
Jackaroo	G. Marler	8	3	117¼	2	5	104¼
Tiger Moth	B. J. Snook	21	11	126¼	11	2	118
Tiger Moth	G. M. Cazalet	14	4	124¾	7	10	109¼

* Disqualified. † Retired.

WELSH MISCELLANY.—Top to bottom (L.H. side), J. Stewart-Wood, who flew the Auster V, G-AIKE, to victory in the White Waltham-Cardiff event; John Severne, first home in the Norton-Griffiths closed circuit; Dennis Hartas, winner of the Air League Trophy in the Jodel D.117; Percy Blamire, first home in the A.L.T. closed-circuit. (R.H. side), the winning Auster; Blamire's Gemini leads the Jodel; and Miss Sheila Scott, victor in the D.H. Tiger Moth Trophy event.

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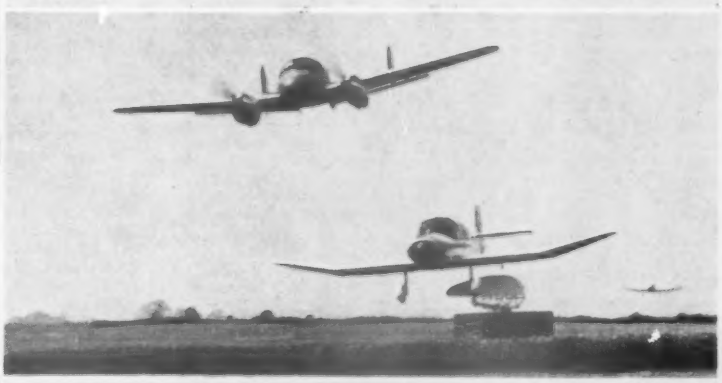
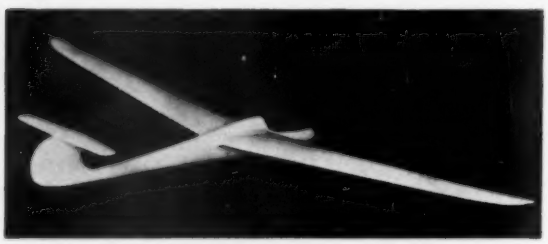


The Gliding Championships

By Dr. A. E. Slater

Adam Witek of Poland beside his Standard Class sailplane, the Foka.

BUTZWEILER, near Cologne, where the World Gliding Championships are being held, is jointly run by the British and Belgian Air Forces as a maintenance airfield. For the past three years seven local gliding clubs have been allowed to use it. Negotiations with the Station Command to use it for the Championships started 16 months ago, after similar negotiations to use Karlsruhe airfield fell through. Orders to give all possible help were received from both London and Brussels, and in the end the only objections came from the German workers on the airfield and from the footballers of Cologne, who protested at the municipal Sporting Committee voting DM.100,000 towards the expense of running championships for a sport other than their own.



A model of the German lightweight, the glass-fibre-and-balsa Phönix, to be flown by Ernst-Günther Haase.

An unidentified Olympia had circled in a thermal above Ann Welch's house at Farnham as we left at 15.00 hrs. on Saturday, May 28, for Germany. Was it a good omen? At least it presaged an uneventful journey for the four Standard Vanguards and three trailers to Butzweiler airfield. But though they arrived in mid-morning next day, there were no thermals at the other end of the journey. Instead, it rained for the remainder of this, the first "practice day."

The British party had been greatly cheered on arrival to see the face of Sergeant Andy Gough, of the R.A.F., shining through the rain; among other useful work he had done behind the scenes, was to have arranged the loan of a Weihe from the local branch of the R.A.F. Gliding and Soaring Association for the use of our reserve pilot, David Ince.

The sky was again overcast for the second practice day, but it was dry enough for all the teams to go through the usual routine of first rigging their own machines and then going round to see what everybody else had brought. The most original of the novelties is, of course, the German glass-fibre-and-balsa Phönix, which is to be flown by the 1958 World Champion, Ernst-Günther Haase—unless he decides before the end of the practice period that he would prefer a more conventional type.

The materials composing the Phönix have made it so light that it can show to best advantage on days of weak lift when minimum sink in the thermals is more important than high speed between them. However, Haase told me that his Phönix should fly considerably faster than the original one, not because of any major change in the wing section but because he has put so many instruments and other equipment into it, and, in addition, he is no lightweight. The most obvious difference in Phönix No. 2 is that the elevator is perched on top of the rudder.

Dick Johnson's new RHJ-6 also has its elevator in that position. The machine is so new that he has not yet painted the fuselage, except for a few unsightly splodges in front. He has, at least, flown it already, though it has not been Dick Johnson's habit to fly much, if at all, between championships ever since he put up his World distance record of 535 miles in 1951. (It has, we hear, just been beaten at last by a Czechoslovak pilot.) The American entry in the Standard Class, a Schweizer 1-23, turns out to be of metal as usual, in spite of a rumour that it would be of wood to help laminar flow.

The two Polish Zefirs, Nos. 1 and 2, differ little from each other: each has a much swept-back rudder and fin, and the fuselage is exceedingly slim. Its vertical diameter has been cut down by making the pilot lie almost on his back, but his chin does not really sink into his chest, as one might suppose, and Adam Witek says that he finds this position quite comfortable. Witek's new Standard Class machine, the Foka, superficially looks very like a reduced Zefir, but is really quite a different design.

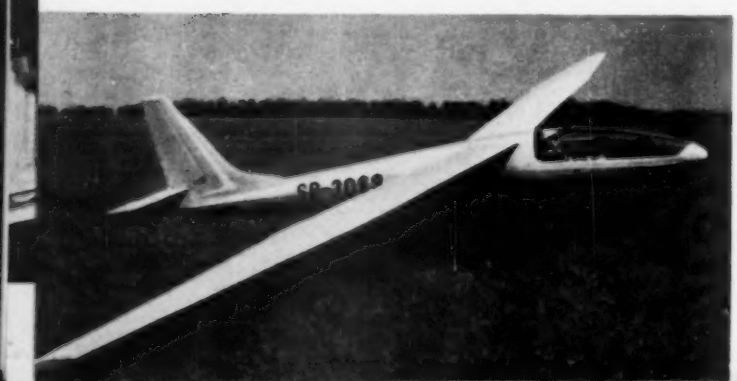
A curious feature of two new Italian machines, one in each class, is that the clear-vision panel on the side of the canopy instead of sliding sideways rotates on a vertical axis, so that, when you open it, half its surface acts as an air brake. In addition, the official air brakes in the Standard Class Uribel are five in number per side, each between a pair of ribs.

What with rain, fog and haze on the first three practice days, an American was heard to remark that now he understood why all the European gliders had such good blind-flying equipment. The fourth day, however, was good enough for the organizers to set a task—just for practice. It was a race to Dahlemer Binz, 41 miles to the south, and back. Launches began at 12.30 hrs., at intervals of 30 seconds, though in fact the Dornier 27s can do better if they are allowed to try; recently, one of their pilots told me, 10 of them launched 25 gliders in five minutes. They tow at 60 knots but can still fly at 31, and have three-position flaps with a maximum extension of 40°.

On this first trial D. Barbera of France, in a Standard Class Fauvette, was first back in 2 hr. 50 min., followed by E. Makula of Poland in a Zefir, I. Silesmo of Sweden in a Ka-6, R. Comte of Switzerland in the Elfe, Nick Goodhart in the Olympia 419; then Witek, J. Ortner of Argentina and Tony Goodhart, who passed over a grounded Tony Deane-Drummond a few miles before the finish with 600 ft. to spare, picked up more lift and got home.

The whole Russian team has cancelled its entry, and so have the Hungarians, while the Czechoslovak entry is still in doubt at the time of writing. All the Poles have come, but the three Yugoslav entries have been reduced to one. The single Canadian pilot also has been unable to get away. So the original 27 nations has been reduced to 24 and possibly 23, and the pilots from 67 to 58 or 55.

Mr. Tony Gaze of the Australian team had the misfortune to damage his tailplane when landing in a cornfield on Jne. 1. A spare tailplane belonging to Mr. Frank Irving, a member of the British ground crew, was flown out from England at once so that Mr. Gaze could continue flying.



The new Polish Zefir in which the pilot reclines almost on his back, an attitude which is reported as "quite comfortable."

Air Transport

Public or Private?

THE fact that the hearings before the Air Transport Licensing Board are normally to be held in public has been accepted by the various airlines with what are euphemistically known as mixed feelings. In other words, quite strong views are held about the principles and procedures involved.

To some extent the principles are similar to those met when debating the question of whether accident inquiries should be held openly or *in camera*. The open inquiry allows the public to hear and to see that justice is being done, but inhibits free evidence and full comment; the closed inquiry encourages, by its nature, the untrammelled discussion of all the evidence, but leaves final judgment in the hands of too few individuals. Either way some of the truth may be hidden or distorted. It is likely that, so far as the future A.T.L.B. proceedings are concerned, the advantages of public hearings will outweigh the disadvantages.

The advantages are that the chances of any successful distortion of the factual evidence will be eliminated, even though a great many of the proceedings, at least initially, will be held in private. Such private sessions will be essential when dealing with evidence which might have diplomatic repercussions and when discussing the financial affairs of private companies.

The disadvantages are that the opportunity may be taken of playing to the gallery—so that, as with the American C.A.B. hearings, the facts may be smothered by public relations—and that much of the informality and friendliness of the A.T.A.C. type of a typically British private hearing must inevitably be lost. Every possible effort must be made to ensure that at least some of the old informality can be retained during the A.T.L.B. proceedings.

For this reason, if for no other, it will be a great mistake if counsel have to be retained, except, perhaps, in those few cases where difficult legal questions are paramount. The hearings are, after all, concerned primarily with economics, which are usually the only really vital factor concerned. Legal questions play a very subsidiary part in the problems being discussed and have not loomed large in the work of the present A.T.A.C.

The full-scale introduction of legal counsel will be costly and will inevitably result in delayed findings—with the possibility, too, that the essential facts may sometimes be hidden behind rhetoric, however well-briefed and well-informed counsel may be. The air transport business is a specialized and peculiar one, and only those who are actually in this business know what the figures and facts really mean in actual practice.

Luckily, it seems that the majority of the airlines would prefer to avoid, so far as is possible, the introduction of the panoply of professional law and to keep the hearings simple and to the point. There are other practical reasons for such avoidance. Apart from the question of cost, it would seem to be unlikely that really first-rate counsel could be retained indefinitely on work of such comparatively limited interest and importance. Nevertheless, if one airline insists on retaining the services of counsel, then others will need to follow suit.—H.A.T.

The Turbojet in Europe

A TENTATIVE assessment of the competitive influence of the jet transport in Europe has recently been made by the Air Research Bureau, and indicates the extent of the diversion of traffic to the jet which has occurred. On the small number of stages for which a direct comparison could be made, operators who introduced jet equipment during 1959 increased their proportion of total passenger kilometres in the fourth quarter from 36% to 44% and—more significantly—improved their average load factor by 10.7 percentage points. The operators on the same sectors who continued to use piston-engined aircraft experienced a 3.0 point drop in load factor.

The A.R.B. comparison, the results of which are shown in detail below, was based on the only nine sectors of international European traffic where one operator had converted completely from piston or turboprop types between the last quarter of 1958 and the last quarter of 1959, and where at least one other operator was flying piston or turboprop types for the whole of both these quarters. These stages, as it happened, were "end" or "middle" stages of multi-sector routes, which influenced the nature of the passenger traffic. Most of the nine sectors were located in the eastern Mediterranean.

	Seat-km. (Thous.)	Pass-km. (Thous.)	L.F. %	% of Total Pass-km.
Jet Operator				
Piston: 4th qr. 1958 ..	28,511	12,292	43.1	36
Jet: 4th qr. 1959 ..	32,040	17,226	53.8	44
1959 as % of 1958 ..	112	140	—	—
Non-jet Operator				
Piston: 4th qr. 1958 ..	45,319	21,949	48.4	64
Piston: 4th qr. 1959 ..	48,421	21,999	45.4	56
1959 as % of 1958 ..	107	100	—	—

Behind the IATA Crisis

ALTHOUGH the detailed proceedings of the IATA Traffic Conferences are never made public, it has been an open secret that the crisis which led the 1959 Conferences at Honolulu to adjourn without agreement was the position taken up by B.O.A.C. Some of the facts of this situation, which was without precedent in the annals of the Association, have now been placed on record by Mr. Ralph Cohen, IATA's public relations officer, in a paper before the Centro per lo Sviluppo dei Trasporti Aerei in Rome.

After outlining the issues which "were the normal result of the technological change within the industry," Mr. Cohen went on to say that something new was added at Honolulu with the demand for very low fares—lower than the normal concept of economy class—between Europe and points in Africa and in the Far East. The demand was voiced by British airlines, supported by flag carriers of other Commonwealth countries, and it arose "out of the waxing tide of their economic prosperity and the desire of a traditionally travel-minded people to resume their wanderings after years of post-war denial."

Distinctive nacelles of the General Electric CJ-805-23 turbofans are shown on this model of the Caravelle 7 (see our previous issue). General Electric will take delivery of Caravelle No. 42 next month for a trial installation of these engines.

In the areas concerned these proposals "opened the lid of Pandora's box." While reductions of fares on some routes might produce a larger flow of traffic, on other routes the result might be commercial disaster. Some of the areas had large populations with strong ties to Europe; the people of others had no concern beyond the next village or mealie patch.

Mr. Cohen continued: "It was on this problem which the Honolulu Conference foundered. In the light of past experience, it was certainly not beyond the capacity and ingenuity of the Conferences to find a *modus vivendi* by which this demand could be accommodated along some routes without fatal consequences elsewhere; but a situation had been created which in effect destroyed the ability of the airlines to negotiate on the matter. The catalyst was a relatively simple statement by a responsible Minister in Parliament that its flag carriers would get exactly what they had asked for or would go it alone, but it nailed the country's flag to the mast of a specific proposal. Any substantial alteration in that proposal could not have been entertained by the Government without a serious loss of prestige."

With this question unresolved, the Conference could not close fares between Europe and Africa and the Far East. As a natural consequence, it was further impossible to close them

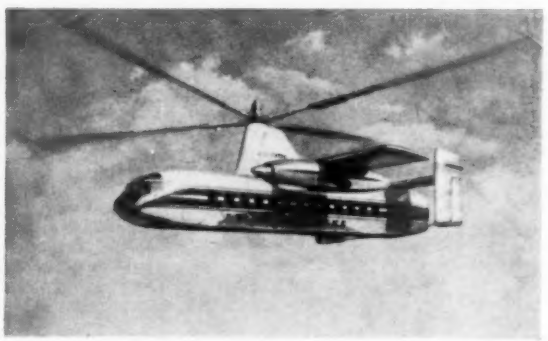
Air Transport . . . .

over the North Atlantic and Pacific. Some fares were closed, but the Conferences adjourned *sine die* without any idea as to when, or even whether, they might meet again.

Yet six months later these differences—and all the other problems which waited on their solution—were resolved. How was this possible? Mr. Cohen gave the following answer: "Delegates had gone home to reconsider their own positions, to confer with their managements and to speak with their governments. They also went home to face the actual threat of a year without rate agreements more directly and immediately than they had ever done before. This was in itself a sobering prospect. . . . But the major change which permitted another Conference session at Paris was, in fact, a change of Ministers; an election had intervened, a new Ministry was created, and whilst the flag was by no means hauled down, it was left more free to react to the winds whipping around the pole. Released from categorical demands, the airlines now had sufficient manœuvring space to negotiate agreements which secured much the same effect by other means."

The episode demonstrated, said Mr. Cohen, that governments hold the whip hand over international fares and rates and that their voice, when they care to raise it, is absolutely decisive. It also made clear that this power must be exercised with some restraint if the Conference process is to work. If "government pronouncement had not so greatly diminished the area of negotiation, the Conferences might well have reached at Honolulu the settlement they were forced to wait until Paris to achieve."

The Rotodyne for Commercial Operation



SINCE the Kaman Aircraft Corp. obtained the U.S. manufacturing and sales rights in the Fairey Rotodyne in July, 1958, the company has been conducting extensive studies to determine its operating expenses, operating capability, and its economic application to scheduled airline operations. Some of the results of these studies were indicated in a paper presented in Dallas this week by Kaman's director of commercial sales, Mr. David E. Postle.*

The Rotodyne, said Mr. Postle, will mark a new era in direct air travel between cities. Over any route on which it is operated, the Rotodyne will capture the majority of all present short-haul passengers carried by the fixed-wing transports, and it will cause a substantial diversion of those now using the automobile, the bus and the railroad for inter-city travel to consistent travel by air.

Mr. Postle's paper started with a consideration of the basic requirements for short-haul transportation (block distances up to 300 miles), and the aircraft flight characteristics necessary to meet them:—

(a) Direct city-centre to city-centre operation. This will eliminate present limousine or taxi trips between the airport and city, the frustrations of three-carrier service, and will save a great deal of travel time.

(b) Convenient locations within cities for the arrival and departure of flights. This will bring air transportation to the prospective passenger, and will make air travel readily accessible to the public. Such a location must include provision for automobile parking and nearby ground transport such as bus lines, subways and taxicabs.

(c) Punctuality of schedules which, except for rare conditions of the most severe weather, will be entirely reliable.

With these basic elements, the flight characteristics necessary for an aircraft to perform successfully in short-haul operations become quite evident:—

1. The ability to land and take-off vertically cannot be compromised. The STOL type of aircraft which requires even a short take-off or landing run would need too large an operating area, and would automatically remove a possible location for the landing facility from a convenient location within a city.

2. Punctuality of schedules and safety of operations require complete instrument capability, full anti-icing provisions, and multi-engine power with adequate performance in the case of failure of one power unit.

3. Adequate net payload capability under all operating situations coupled with a reasonably high cruising speed are basic ingredients to economic operating expenses. In Mr. Postle's view, to the end of reducing operating expenses per seat-mile and to meet airline scheduling requirements for today and the future, seating capacity for such an aircraft must be not less than 30 seats and probably not more than 70 seats.

4. A minimum cruising speed of 175 m.p.h. is essential to reducing operating expenses. Higher cruising speed is desirable, but a speed of more than 250 m.p.h. is unnecessary in short-haul operations if the added speed is attained at a penalty in operating expense. Passenger time saved with such higher speeds is a matter of only a few minutes over a block distance of 100 miles, which is the probable average flight distance for aircraft engaged in this type of operation.

Only the convertiplane, in one form or another, can meet these requirements. The configurations considered by Mr. Postle included all aircraft having tilting wings and rotors, those having fixed-wings with tilting or retractable rotors, those having deflected airstreams, and all helicopters having stub wings or auxiliary thrust units or other means of unloading the rotor system in flight. Lack of funds has limited the research and experiment necessary for the full development of some of the configurations and it is too early to forecast accurately their net payloads, effective ranges and economics.

It appeared to the author that tilt-wing and tilting-rotor types might prove highly efficient at longer distances, but below 300 miles their net-payload-to-gross-weight ratio will make them inefficient. Only one convertiplane configuration—the helicopter with off-loaded rotor—has so far proved its value and meets all the requirements. And of this type, only the Rotodyne has been developed and sufficiently flight-tested to assure its commercial success.

Kaman has investigated the times taken to travel from one city centre to another over various high-density airline routes by Rotodyne, and the results of some of these comparisons are tabulated below:—

	Rotodyne	Airline/limousine	Time saved by Rotodyne
New York-Washington	1 : 27	2 : 33	1 : 06
Detroit-Chicago	1 : 38	3 : 36	1 : 58
Boston-New York	1 : 21	2 : 54	1 : 33
Syracuse-New York	1 : 23	3 : 00	1 : 37
Los Angeles-San Diego	0 : 42	2 : 30	1 : 48
Chicago-St. Louis	1 : 45	3 : 48	2 : 03

The airline/limousine times are based on the fastest non-stop airline schedule, with 15-minute pre-flight and post-flight allowances, and published limousine times. The Rotodyne times include 15 minutes for pre-flight, check-in and boarding. The Rotodyne will save an average of 55% of the present airline travel time between city centres—and in several instances will arrive at its destination before the airliner flying on the same route has become airborne.

Block speeds and scheduling times have been computed for standard operating flight procedures in vertical take-off, climb to 2,000 ft., 3,000 ft. and 4,000 ft. cruising altitudes, let-down and zero speed landing and 2-min. taxi time at each end of the flight. Taking present one-way airline fares and adding limousine fares for both ends of the journey, Kaman has calculated that the Rotodyne will operate over almost all routes at a break-even load factor of 55% or less.

The Rotodyne can be expected to operate with a high degree of punctuality, since it operates, like helicopters, at altitudes below those of the fixed-wing aircraft and will not be subject to extensive air traffic delays. By diverting short-haul traffic away from airports, the Rotodyne will also contribute to a speeding-up of the long-haul fixed-wing flights. "We are," said Mr. Postle "experiencing a very genuine interest in the Rotodyne on the part of several scheduled airlines."

* "Convertiplanes in Commercial Operation," by David E. Postle, at the A.S.M.E. Aviation Conference, June 5-9.

DC-8 Anniversary

TWO years and a few days ago, THE AEROPLANE AND ASTRONAUTICS—alone among European aviation journals—witnessed a first flight of more than usual significance. On May 30, 1958, at 10 minutes past 10 in the morning, we saw the Douglas Aircraft Co. enter the jet transport era as test pilot A. G. Heimerdinger lifted the first DC-8 smoothly into the air at Long Beach Municipal Airport.

To witness the first flight of any new Douglas commercial transport would be memorable; that of the DC-8 was more so since the company's reputation as producers of the World's most renowned transport aircraft was at stake. For three years, Douglas engineers had been involved in one of the most ambitious programmes they had ever undertaken—ambitious not because the end product was to be significantly more advanced than the rival 707, but because many of the stages in development were being telescoped to reduce Boeing's lead.

In that aim, it appears two years later, Douglas has not been wholly successful. While orders for the DC-8 total 153, those for the Boeing 707 in all its varieties total 212—and neither company has yet made a profit on its jet transports. This discrepancy in orders is the price Douglas has paid for being second with a big jet and, perhaps, for failing to diversify the basic design into a variety of types; the Boeing sales total includes 56 of the medium-haul 720s, ordered to do a job for which the DC-8 is not suited.

Statistics published by Douglas to mark the second anniversary of the first flight show that the company has invested to date more than $253 million in the DC-8 programme, of which 43% has been disbursed to suppliers and sub-contractors. Fifty-seven DC-8s had been delivered by May 30 this year, and production had started on the 119th. Deliveries have been made to 12 of the 18 DC-8 customers. In a little more than eight months of airline service, these 12 airlines together have flown 46,000 hours, while Douglas has completed 3,200 hours of instrumented test and development flying in two years.

Too Little Freedom

RATHER more than a year ago, in the issue of May 15, 1959 (pp. 568-9), we published an article pointing out some of the international restrictions by which the air charterer, in particular, has been hampered through the years.

Yesterday the Airbrokers' Association issued a little booklet, "The Freedom of the Air," outlining the history of these restrictive practices and giving seven particularly uncomfortable examples. The comments are the result of 11 years' experience among the Airbroker membership of the Baltic Exchange—which is the World's only international air chartering market.

The booklet points out that it is sometimes necessary to apply for clearances for charters as long as 60 days before the date of the flight and that these clearances may not, in the end, be granted. Such refusals are generally the result of efforts to protect the national airlines. When clearance has been obtained it is sometimes necessary to pay a commission to the national airline even though the latter was not in a position to do the job.

The Airbrokers' Association suggests that an educational effort should be applied to government regulatory agencies and that, for a start, an attempt should be made to secure, through IATA, general consent from leading international carriers to a special status for charters.

European Traffic Trends

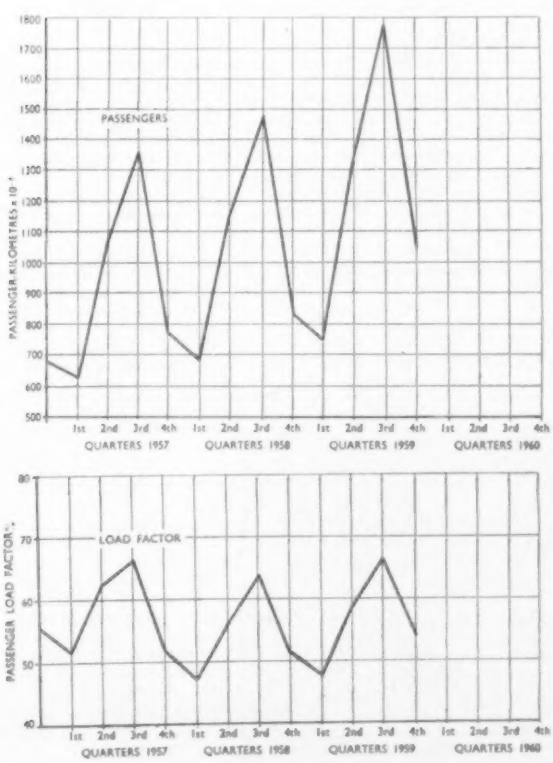
LATEST quarterly figures issued by the Air Research Bureau for European traffic—in respect of the last quarter of 1959—show a further improvement in the growth rate. The increase in passenger kilometres was 19.3% over the corresponding quarter of 1958, and brought the annual rate of increase for 1959 to 13.3%, compared with 8.9% in 1958. The growth rate in European traffic, according to the A.R.B., declined steadily from 10.6% in the first quarter of 1958 to a "low" of 6.1% in the first quarter of 1959, since when it has been climbing rapidly. The increases for the four quarters of 1959 were 6.1%, 12.2%, 14.1% and 19.3% respectively.

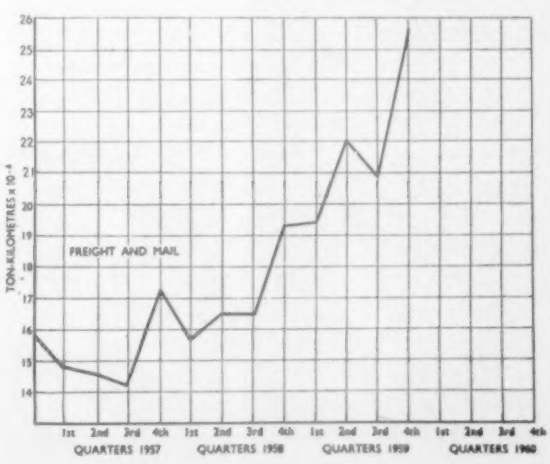
A significant feature for the fourth quarter was the increase in first-class traffic, which rose from 5.6% (1957) and 7.7% (1958) to 9.3% of the total passenger traffic. Passenger load factors in 1959 rose healthily to 58.2% from 55.2% in 1958.

Freight traffic once again showed a strong growth: 27.8% for the fourth quarter and 24.7% for the year. There was a 70.2% increase in the amount of freight on all-freight services, and a 21.6% increase on passenger services in the quarter.

During 1959, jet aircraft have begun to appear in Europe, and in the fourth quarter were responsible for 8.2% of the passenger kilometres flown. The proportions of piston-engined, turboprop and turbojet operations for the four quarters of 1959, on the basis of passenger kilometres, were as follows:—

	Piston	Turboprop	Turbojet
First quarter ...	57.9%	42.1%	0.0%
Second quarter ...	50.9%	46.7%	2.4%
Third quarter ...	45.7%	48.3%	6.0%
Fourth quarter ...	48.4%	43.4%	8.2%





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Air Transport . . . .

The Gulfstream Comes to Town

A YEAR ago, in June, 1959, Grumman delivered its first Gulfstream twin-Dart executive transport. By the beginning of June this year, when a Gulfstream visited Europe for the first time, 36 Gulfstreams had been delivered and a total of 48 ordered. The Gulfstream has thus established itself as the best-selling new executive aircraft in its class, justifying the care with which the makers surveyed the needs of the U.S. corporate owners before embarking on the design early in 1957. Sales to date are still far short of the break-even point—estimated by the company at between 125 and 150—but sales prospects seem good and should support the present production rate of between three and four a month.

The Gulfstream's first visit to Europe was a routine business trip by the chairman of National Distillers and Chemical Corp.—a typical Gulfstream user. National Distillers started operating a Gulfstream in December and had flown over 300 hr. in this aircraft at the time of its European visit; a second Gulfstream has been acquired more recently. The Gulfstream's brief presence at Gatwick during this trip afforded THE AEROPLANE AND ASTRONAUTICS an opportunity to sample executive-type flying in the modern idiom, and to meet National Distillers' enthusiastic chief pilot, Harold Curtis. Full of praise for the reliability of the Rolls-Royce Dart engines, Capt. Curtis said the Gulfstream handled better than the DC-3—it was "a real baby carriage."

This particular Gulfstream was furnished to carry nine passengers—seven in comfortable individual swivel seats and two on a corner couch at the rear of the cabin. There was, in addition, a 3-seat divan, not usable during take-off and landing. All Gulfstreams are furnished to the individual requirements of their owners, 8-10 seats being typical. Grumman produces only a bare airframe, which is then furnished by one of the four distributors—three in the U.S. and one in Canada. Basic price of the bare Gulfstream is now $896,000, the addition of cabin furnishing, radio and electronics bringing the first cost up to over $1 million.

Measured by airline standards, the Gulfstream would not be a cheap aeroplane to operate—especially in terms of seat-mile costs. Annual utilizations seldom run into four figures, and some corporate owners write-off their new equipment over as short a period as five years. Corporate owners can afford, on the other hand, to take a rather different view of these costs from an airline struggling to make a profit.

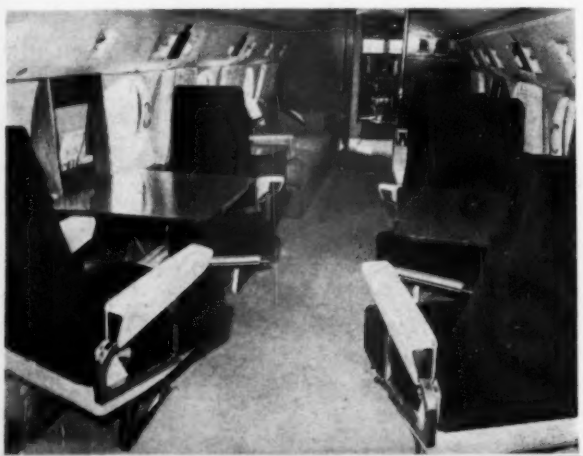
Gulfstream flight-decks vary according to customer preference, within fairly closely defined limits set by the basic structure. Two-pilot operation is usual, with full dual control, and a comprehensive radio rack behind the right-hand seat and facing the main entrance door. Many corporations also include a flight engineer/cabin attendant in the crew.

The Gulfstream was designed to operate from any airfield used by a DC-3. This—and the requirement for a high cruising speed—dictated the use of Dart R.Da.7s rather than the more widely used and economical R.Da.6s. The basic structure is, in fact, adequate for the 2,660 e.h.p. R.Da.10 engines, to give a 400 m.p.h. cruise. The Darts, with their associated Dowty Rotol propellers, accessory drive equipment and engine synchronizing gear, represent 23% of the basic price.

Present gross weight of the Gulfstream is 33,600 lb., including 10,400 lb. of fuel to give a maximum range of 2,200 st. miles (with 200 miles and 45 min. reserve). A 1,000 lb. increase in gross weight is planned, and will be accompanied by the introduction of vortex generators on the rudder to improve control with the critical engine out and hold the minimum control speed to its present value of 100 knots.

The Gulfstream is designed to be wholly independent of external services, and includes, in addition to airstairs, engine starters, ground cabin air conditioning and an electric source for radio, lights, etc., when the engines are not running.—F.G.S.

A glimpse of the flight deck. Controls for de-icing, electrics, A.P.U. and cabin pressurization are in the upper overhead panel. Starter buttons, propeller controls and fuel switches are in the lower overhead panel and the master warning light system and emergency switches are along the top of the coaming.



This typical Gulfstream interior has seven individual chairs and three fold-away tables. Forward of the cabin is a small galley and, on the right, the radio rack. At the rear of the cabin is a toilet and access to the rear luggage hold, loaded through an external door in the starboard side.

EVEN BETTER THAN PROMISED

Before the first Vanguard goes into scheduled service, and little more than a year after the first flight tests, development has made possible dramatic increases in maximum operating weights. Details are given in the table below. These improvements have been achieved for an empty weight increase of only 600 lb, and allow a margin of 1,600 lb for future development, equipment changes or customers' special requirements.

VANGUARD PAYLOAD UP BY 8,000 lb

	Original specification	New specification	Increase
GROSS TAKE-OFF WEIGHT	141,000 lb	146,500 lb	**5,500 lb**
MAX. LANDING WEIGHT	121,000 lb	130,500 lb	**9,500 lb**
MAX. 'ZERO FUEL' WEIGHT	112,500 lb	122,500 lb	**10,000 lb**
MAX. PAYLOAD	29,000 lb	37,000 lb	**8,000 lb**

The Vanguard can now carry 139 economy-class passengers plus over 8,000 lb freight. Without intermediate refuelling, 100-passenger payloads can be carried over such important consecutive sectors as London–Frankfurt–Vienna–Prague.

Operators with profit in mind and air travel for all in view, will find the Vanguard is more attractive than ever.

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The operating subsidiaries, Vickers-Armstrongs (Aircraft), English Electric Aviation and Bristol Aircraft, though merged, will continue to operate under their own names in order to preserve continuity of responsibilities and service.
Behind British Aircraft Corporation lie the strengths of the Vickers, English Electric and Bristol Groups.
Negotiations have been completed with the Hunting Group for British Aircraft Corporation to acquire a controlling interest in Hunting Aircraft.

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Short **BRITANNIC**

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De Havilland **COMET 4**

Canadair **CL.44**

Canadair **CL.66**

Grumman **GULFSTREAM**

Fokker/Fairchild **F.27**

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Vickers **VANGUARD**

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Britain's Research Flat-Riser

WHEN the Short SC.1 made its first complete transition from hovering to forward flight on Apr. 6 last, at the R.A.E. Bedford (THE AEROPLANE AND ASTRONAUTICS, Apr. 15), there came the end of the opening phase in the development of Britain's first flat-rising VTOL aeroplane. As a pure research vehicle, the SC.1, in its present form, has no operational application. But its successful demonstration that a fixed-wing aeroplane can now have a speed range with a zero lower limit, presented a most significant indication of the potential scope offered by the coming generation of turbojet VTOL aircraft.

It must not be thought, however, that this is the limit of the SC.1's usefulness. It has, indeed, succeeded in attaining its original objective, but there now remains the further investigation and assessment of its various performance characteristics to provide know-how and data for future designs based on similar principles. Moreover, much still remains to be done in developing its specialized auto-stabilization system beyond the experimental type of installation into a form that would be suitable for incorporation in operational VTOL aircraft of this type.

The basic power unit for the SC.1 is the Rolls-Royce RB.108 lightweight turbojet with a maximum thrust rating of 2,010 lb.st. Specially developed for this type of application the RB.108 is an axial-flow engine designed specifically for operation as a vertically mounted jet-lift engine. As such it represents a distinct contribution to power-plant technology, and can no doubt be regarded as the forerunner of other designs with even better thrust/weight ratios and specific fuel consumption.

In point of fact the whole SC.1 concept is a logical step in a chain of developments which started with the first successful controlled flight of the Rolls-Royce Thrust Measuring Rig (more popularly known as the Flying Bedstead) in August, 1954. In this respect it is, so to speak, a second generation research vehicle.

The Rolls-Royce team at Derby had demonstrated — crudely but most effectively — that it was possible for a jet-sustained flying platform to be stabilized, by means of subsidiary control jets—or "puff-pipes" as they became known — acting about all three axes. From this, the obvious next step was to apply the principle to a more orthodox airframe, so that the jet-lift VTOL capability and wing-supported forward flight could be combined.

Official interest led to a specification and in August, 1954—the same month that the Rolls-Royce T.M.R. flew — Short Brothers and Harland in Belfast were given a Ministry of Supply contract for the design and construction of an aircraft to it. Prior to this, of course, there had been considerable discussion between the interested parties as to the form this research craft should take. The Short team had some firm views in this respect and their proposals came to be incorporated in the final specification.

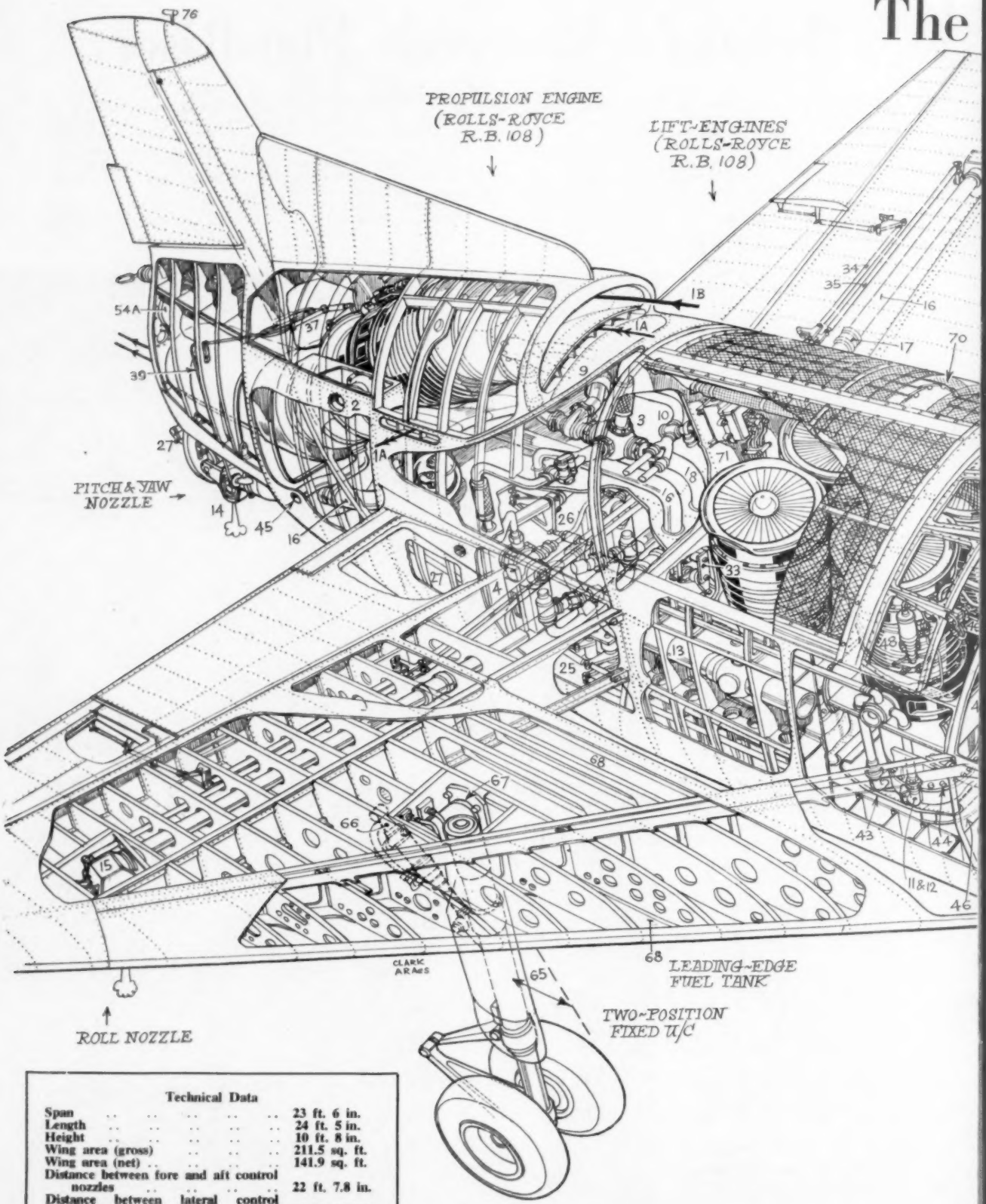
In this context it is interesting to compare the essential differences between the initial Rolls-Royce experimental flying rig and the more sophisticated Short research craft. First

(*Continued on page 704*)

POISED.—The Short SC.1 demonstrates at R.A.E. Bedford that it has no stalling speed.

Photograph copyright "The Aeroplane and Astronautics"

The

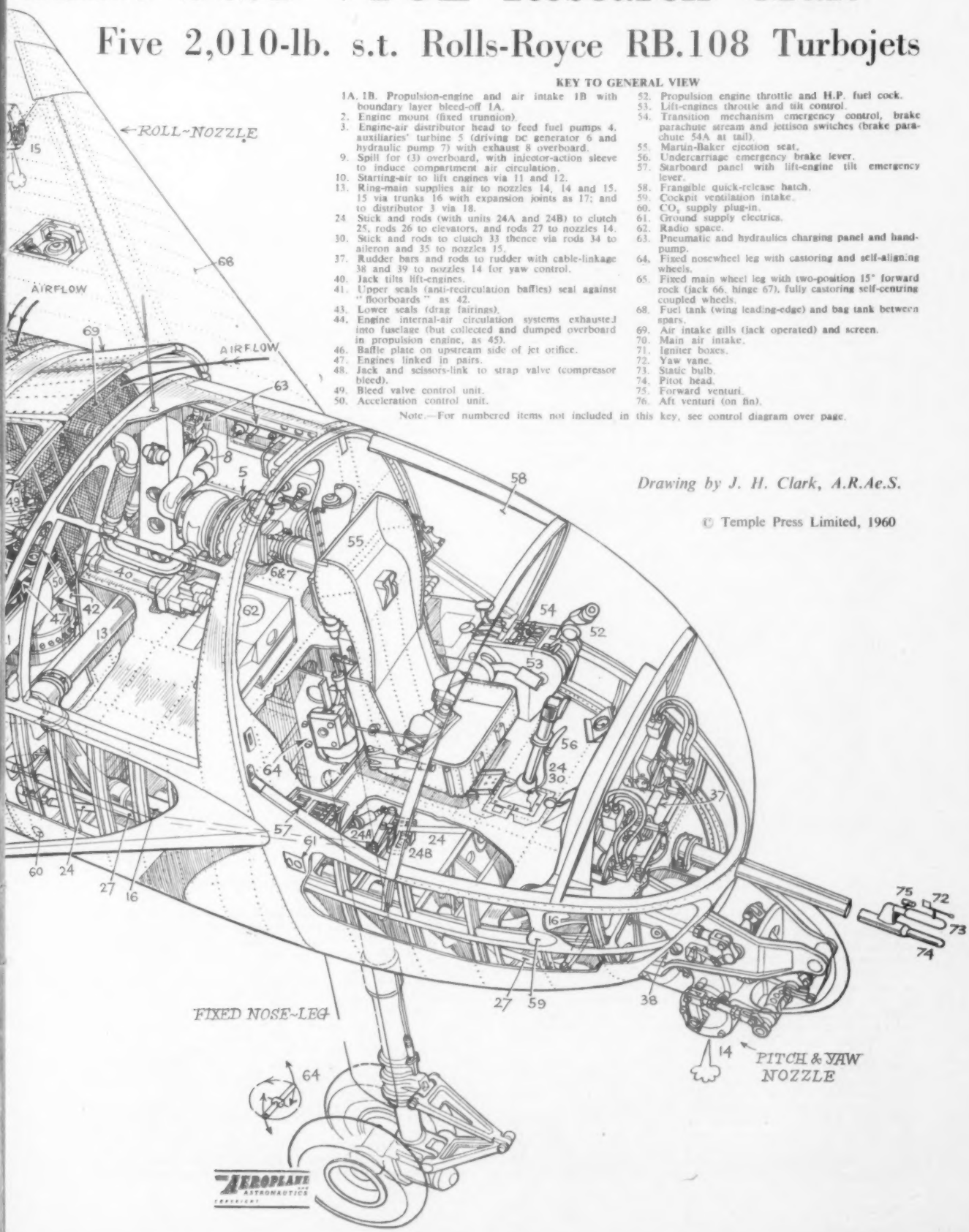


Technical Data

Span	23 ft. 6 in.
Length	24 ft. 5 in.
Height	10 ft. 8 in.
Wing area (gross)	211.5 sq. ft.
Wing area (net)	141.9 sq. ft.
Distance between fore and aft control nozzles	22 ft. 7.8 in.
Distance between lateral control nozzles	17 ft. 6.28 in.

Short SC.1 VTOL Research Craft

Five 2,010-lb. s.t. Rolls-Royce RB.108 Turbojets



KEY TO GENERAL VIEW

1A, 1B. Propulsion-engine and air intake 1B with boundary layer bleed-off 1A.
2. Engine mount (fixed trunnion).
3. Engine-air distributor head to feed fuel pumps 4, auxiliaries' turbine 5 (driving DC generator 6 and hydraulic pump 7) with exhaust 8 overboard.
9. Spill for (3) overboard, with injector-action sleeve to induce compartment air circulation.
10. Starting-air to lift engines via 11 and 12.
13. Ring-main supplies air to nozzles 14, 14 and 15, 15 via trunks 16 with expansion joints as 17; and to distributor 3 via 18.
24. Stick and rods (with units 24A and 24B) to clutch 25, rods 26 to elevators, and rods 27 to nozzles 14.
30. Stick and rods to clutch 33 thence via rods 34 to aileron and 35 to nozzles 15.
37. Rudder bars and rods to rudder with cable-linkage 38 and 39 to nozzles 14 for yaw control.
40. Jack tilts lift-engines.
41. Upper seals (anti-recirculation baffles) seal against "floorboards" as 42.
43. Lower seals (drag fairings).
44. Engine internal-air circulation systems exhausted into fuselage (but collected and dumped overboard in propulsion engine, as 45).
46. Baffle plate on upstream side of jet orifice.
47. Engines linked in pairs.
48. Jack and scissors-link to strap valve (compressor bleed).
49. Bleed valve control unit.
50. Acceleration control unit.
52. Propulsion engine throttle and H.P. fuel cock.
53. Lift-engines throttle and tilt control.
54. Transition mechanism emergency control, brake parachute stream and jettison switches (brake parachute 54A at tail).
55. Martin-Baker ejection seat.
56. Undercarriage emergency brake lever.
57. Starboard panel with lift-engine tilt emergency lever.
58. Frangible quick-release hatch.
59. Cockpit ventilation intake.
60. CO_2 supply plug-in.
61. Ground supply electrics.
62. Radio space.
63. Pneumatic and hydraulics charging panel and hand-pump.
64. Fixed nosewheel leg with castoring and self-aligning wheels.
65. Fixed main wheel leg with two-position 15° forward rock (jack 66, hinge 67), fully castoring self-centring coupled wheels.
68. Fuel tank (wing leading-edge) and bag tank between spars.
69. Air intake gills (jack operated) and screen.
70. Main air intake.
71. Igniter boxes.
72. Yaw vane.
73. Static bulb.
74. Pitot head.
75. Forward venturi.
76. Aft venturi (on fin).

Note.—For numbered items not included in this key, see control diagram over page.

Drawing by J. H. Clark, A.R.Ae.S.

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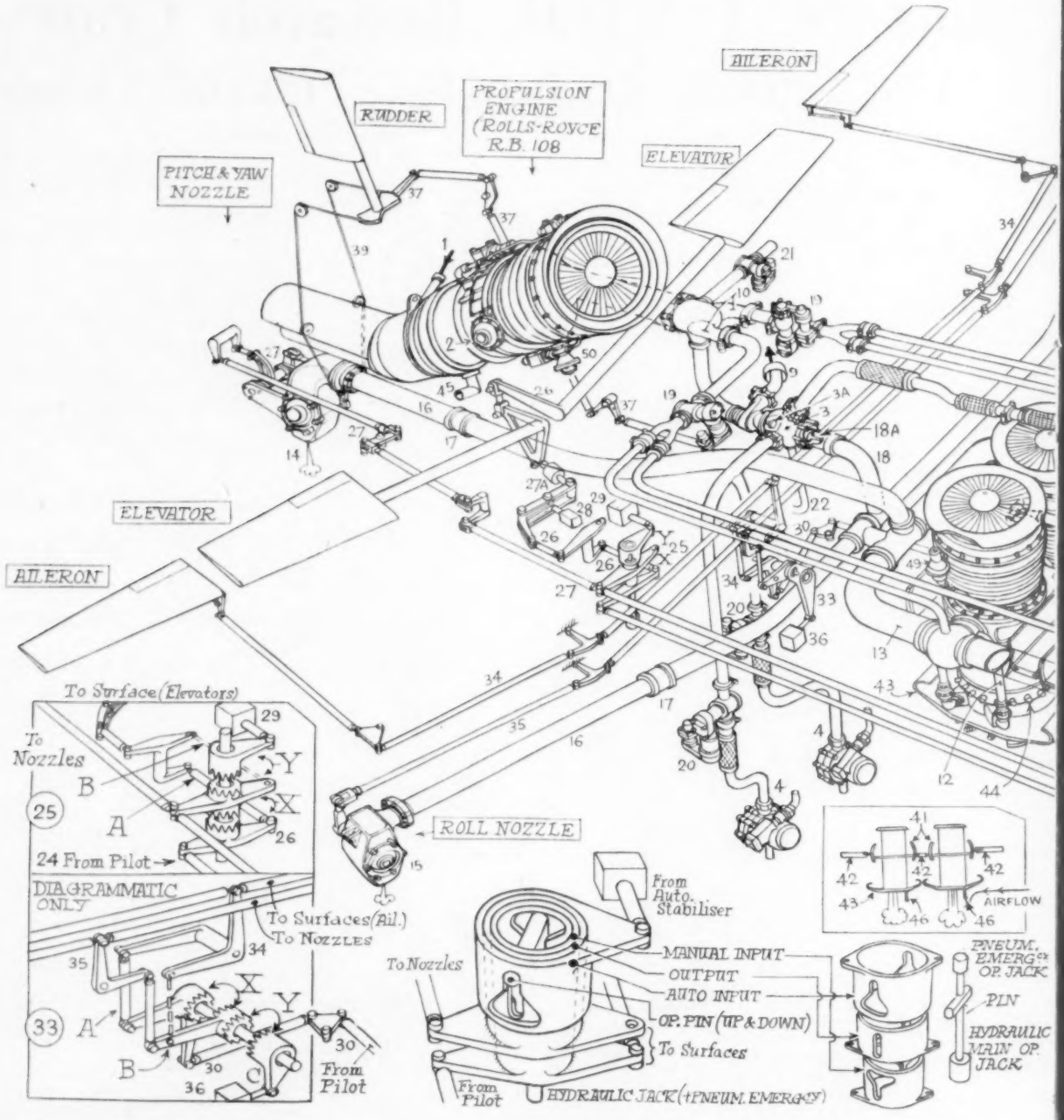


(*Continued from page 701*)

it should be noted that even in the early stage of development of this type of jet-lift VTOL technique, the possibilities of its ultimate application to supersonic aircraft were in mind. For this reason, when it came to the selection of a suitable layout, a delta wing planform was chosen, so that the craft would at least be representative in shape even though its normal flight speed would be well subsonic. A leading-edge sweep of 54° was reckoned to be the best compromise in this respect; and because of the relatively low speed requirement a thick symmetrical section having a 10% t/c was used.

For control of the SC.1 in normal forward flight, orthodox aerodynamic control surfaces—ailerons, rudder and elevators—are provided. These are operated by means of conventional controls in the cockpit via tubular push-pull members.

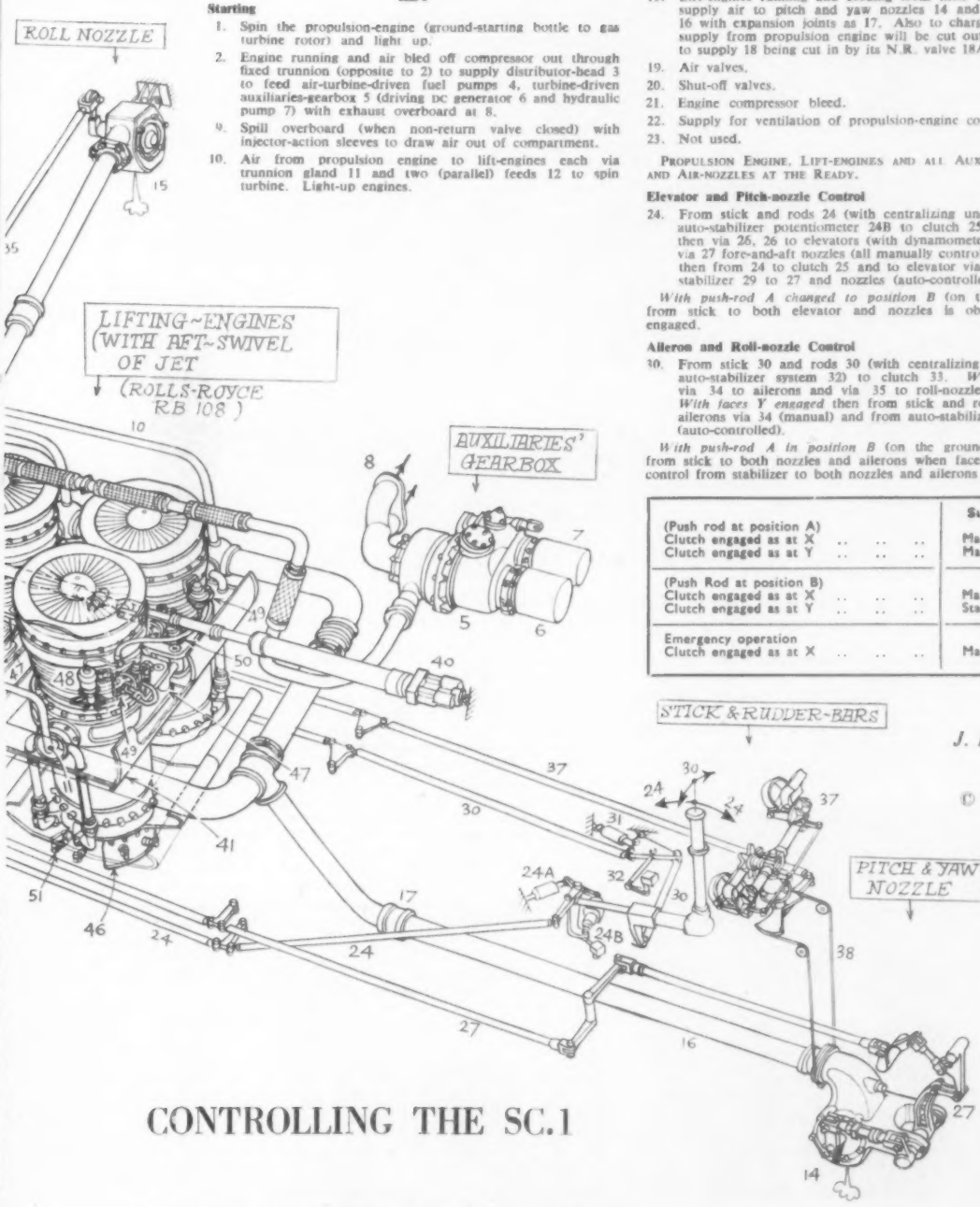
In the case of the ailerons and rudder a straightforward manual system is employed, but in the elevator circuit an irreversible power control unit is incorporated. This was found to be necessary to ensure that during the backward flight, that is possible with this sort of aircraft, the aerodynamic loads do not cause movement of the control surface and give undesirable trim changes that might be difficult to control.

This powered system also prevents adverse or unpleasant loads being fed back to the pilot's control column during vertical ascent or descent. To cater for the event of a failure of the power control there is provision for full manual reversion.

Rolls-Royce interest in VTOL techniques has always favoured the multi-unit type of direct jet-lift powerplant with a number of small engines providing the total lift thrust required. This provides a ready solution to the engine-cut case which is clearly one of the principal problems to be overcome in the practical application of jet-lift VTOL. It also shows to advantage in keeping the individual units at a size that offers the maximum opportunity to minimise s.f.c.

The company has, in fact, been actively engaged in the development of lightweight powerplants for such duties since 1949. And in 1954 when the SC.1 specification became the subject of a contract the team at Derby were in a good position to start work on the powerplant for the Short airframe.

Initially the official proposals, for the jet-lift research aircraft,



CONTROLLING THE SC.1

were centred around four such engines mounted vertically in the airframe. These were to be made capable of being tilted in the fore and aft plane to give a sufficient thrust component for forward flight. Short and Rolls-Royce studied a variety of solutions on these lines with various degrees of engine movement and in combination with efflux deflection systems to provide the requisite propulsive thrust component.

Many problems came to light as a result of these preliminary studies. For example, the use of lift engines for forward propulsion meant that to give the necessary thrust they all had to be kept running in normal aeroplane flight and this resulted in high fuel consumption. Also, the deflection systems were found to give undesirable trim changes. Indeed, it soon became apparent that the most satisfactory solution of all was to have a fifth engine, the sole function of which would be to provide the forward thrust; the final specification was drawn up on these lines.

Clearly, the cluster of lift engines needs to be situated on the aircraft's centre of gravity and the individual units kept as close

(*Continued on page 706*)

KEY

Starting

1. Spin the propulsion-engine (ground-starting bottle to gas turbine rotor) and light up.
2. Engine running and air bled off compressor out through fixed trunnion (opposite to 2) to supply distributor-head 3 to feed air-turbine-driven fuel pumps 4, turbine-driven auxiliaries-gearbox 5 (driving DC generator 6 and hydraulic pump 7) with exhaust overboard at 8.
9. Spill overboard (when non-return valve closed) with injector-action sleeves to draw air out of compartment.
10. Air from propulsion engine to lift-engines each via trunnion gland 11 and two (parallel) feeds 12 to spin turbine. Light-up engines.
13. Lift-engines running and feeding from their compressors ring-main 13 to supply air to pitch and yaw nozzles 14 and roll nozzles 15 via trunks 16 with expansion joints as 17. Also to charge distributor 3 via 18 when supply from propulsion engine will be cut out by its N.R. valve 3A due to supply 18 being cut in by its N.R. valve 18A.
19. Air valves.
20. Shut-off valves.
21. Engine compressor bleed.
22. Supply for ventilation of propulsion-engine compartment.
23. Not used.

PROPULSION ENGINE, LIFT-ENGINES AND ALL AUXILIARIES ARE NOW RUNNING AND AIR-NOZZLES AT THE READY.

Elevator and Pitch-nozzle Control

24. From stick and rods 24 (with centralizing unit 24A and q-feel jack and auto-stabilizer potentiometer 24B to clutch 25). *With faces X engaged*, then via 25, 26 to elevators (with dynamometer 27A power servo 28) and via 27 fore-and-aft nozzles (all manually controlled). *With faces Y engaged* then from 24 to clutch 25 and to elevator via 26 manual and from auto-stabilizer 29 to 27 and nozzles (auto-controlled).

With push-rod A changed to position B (on the ground) manual control from stick to both elevator and nozzles is obtained when faces X are engaged.

Aileron and Roll-nozzle Control

30. From stick 30 and rods 30 (with centralizing unit 31 and potentiometer auto-stabilizer system 32) to clutch 33. *With faces X engaged* then via 34 to ailerons and via 35 to roll-nozzles (all manually controlled). *With faces Y engaged* then from stick and rods 30 to clutch 33 and to ailerons via 34 (manual) and from auto-stabilizer 36 to roll-nozzles via 35 (auto-controlled).

With push-rod A in position B (on the ground) there is manual control from stick to both nozzles and ailerons when faces X are engaged and auto-control from stabilizer to both nozzles and ailerons when faces Y are engaged.

	Surfaces	Nozzles
(Push rod at position A)		
Clutch engaged as at X	Manual	Manual
Clutch engaged as at Y	Manual	Stabilized
(Push Rod at position B)		
Clutch engaged as at X	Manual	Manual
Clutch engaged as at Y	Stabilized	Stabilized
Emergency operation		
Clutch engaged as at X	Manual	Manual

Drawing by J. H. Clark, A.R.Ae.S.

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Rudder and Yaw-nozzle Control

From rudder bars and rods 37 to rudder and with cable-linkage 38 and 39 to swing the fore-and-aft nozzles transversely for yaw (all manual control, no switch-over to auto).

General Details

40. Swivelling jack to tilt lift-engines.
41. Upper horizontal seals (seal the holes in the "floor-boards" 42) to prevent upflow of hot air in the "funnel" formed between the four engines.
43. Lower horizontal seals preserve a near unbroken undersurface of fuselage.
44. Engine internal-air systems exhausted into engine bay (but collected and dumped overboard in propulsion engine, 45).
46. Baffle upstream on each jet orifice to prevent jetstream deflection.
47. Engines linked together in pairs.
48. Jack and scissor link tighten "bandbrake" type of strap valve around compressor (bleed valve).
49. Bleed valve control unit.
50. Acceleration control unit.
51. Seal 43 ghosted away reveals radially placed thermocouples.

A 54° delta, the Short SC.1 has a comparatively wide fuselage to accommodate the four Rolls-Royce RB.108 lift engines in the centre section. The small bulges under the nose and near the wing tips are jet-control nozzle fairings.

together as possible in order to obviate any large trim changes in the event of an engine failure. This, however, brings a problem of its own in that the concentration of all four effluxes does mean that the airframe structure is subjected to a fairly severe heat treatment when the aircraft is on, or near, the ground. With the engines spread farther apart this might be avoided; but in the case of a failure either a considerable trim change would have to be accepted and controlled or the opposite engine would need to be deliberately cut to restore the balance, with consequent severe loss of lift thrust.

Lord Douglas of Kirtleside, chairman of B.E.A., recently saw a demonstration of the SC.1 at R.A.E. Bedford. With him here are Rear Admiral Sir Matthew Slattery, chairman of Shorts (right) and Tom Brooke-Smith, the chief test pilot.

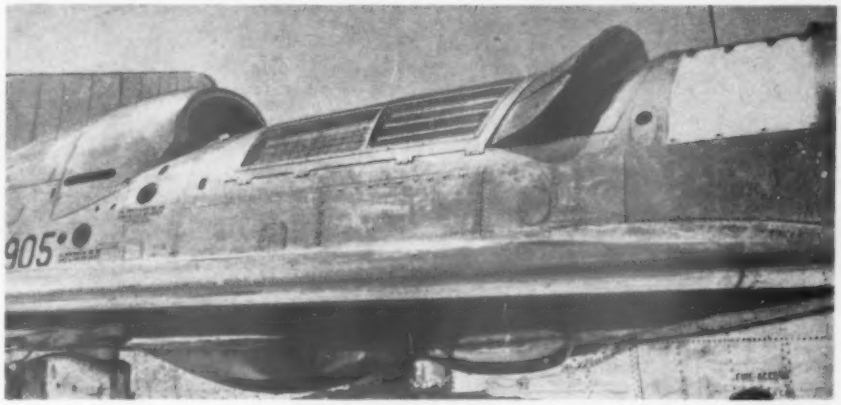
It might, perhaps, be explained here that this heating effect is one of the principal reasons for having a raised grid platform for VTOL operation of the SC.1. This enables the hot gases to be kept clear of the structure. Another, even more important, function of the raised platform is to minimize the ground suction effect brought about by the entrained airflow round the wing into the lift-engine efflux. This is a well-known ground-proximity phenomenon and in the case of the SC.1 was found to reduce the effective lift thrust to such an extent that it was insufficient for take-off; raising the engine efflux by about 18 in. was found to be sufficient to overcome this effect.

Although the basic technique of tilting the lift engines to provide all the forward thrust component was not adopted, such a system was retained as a form of thrust booster. Fuel consumption is always of prime importance and, in order to improve matters in this direction as much as possible, it is clearly an advantage to reduce the transition time from vertical to forward flight to a minimum. The lift engines of the SC.1 can, therefore, be swung fore and aft 30° each side of the vertical to give a component to help accelerate or decelerate the aircraft during its transition phase.

Location of the forward-propulsion engine posed some problems, notably in relation to the overall geometry of the layout. Clearly it is necessary to have the horizontal efflux low down so as to avoid drastic trim changes in forward flight. The intake, on the other hand, has to be high up, on top of the fuselage; it is not possible to have a ventral intake because of its proximity to the hot efflux from the lift engines. The forward-propulsion powerplant is, then, inclined in the rear fuselage at an angle of about 30° between the dorsal intake forward of the fin and the low jet pipe position.

The four lift engines are trunnion mounted in pairs in the fuselage centre-section. Their tilting movement is controlled

Mr. Beverley Shenstone, chief engineer of B.E.A. (second left), discusses VTOL with Air Chief Marshal Sir Ralph Cochrane of Rolls-Royce (centre) and Mr. Hugh Conway, deputy managing director of Shorts (right).



The lift-engine intake on top of the fuselage is in two portions —forward it is closed by normal hinged gills aft of which there is a larger area closed by spring-loaded louvres under a wire mesh. The rearmost top intake (on the left) is for the forward-propulsion engine.

Photographs copyright "The Aeroplane and Astronautics"

by an hydraulic jack, the control valve of which is solenoid operated from a switch on the pilot's control column. The arrangement is such that the engines move relatively slowly and in the present system the angle of tilt is infinitely variable between the set limits. A position indicator in the cockpit enables the pilot to hold the lift engines at any given position.

All five engines have three primary controls each. These are all mechanically operated and comprise: an air cock for starting which controls the flow of compressed air to the starting air nozzle in the low-pressure turbine; a throttle control which varies the high-pressure fuel flow to the burners; and a high-pressure cock which cuts off the fuel supply for stopping the engine.

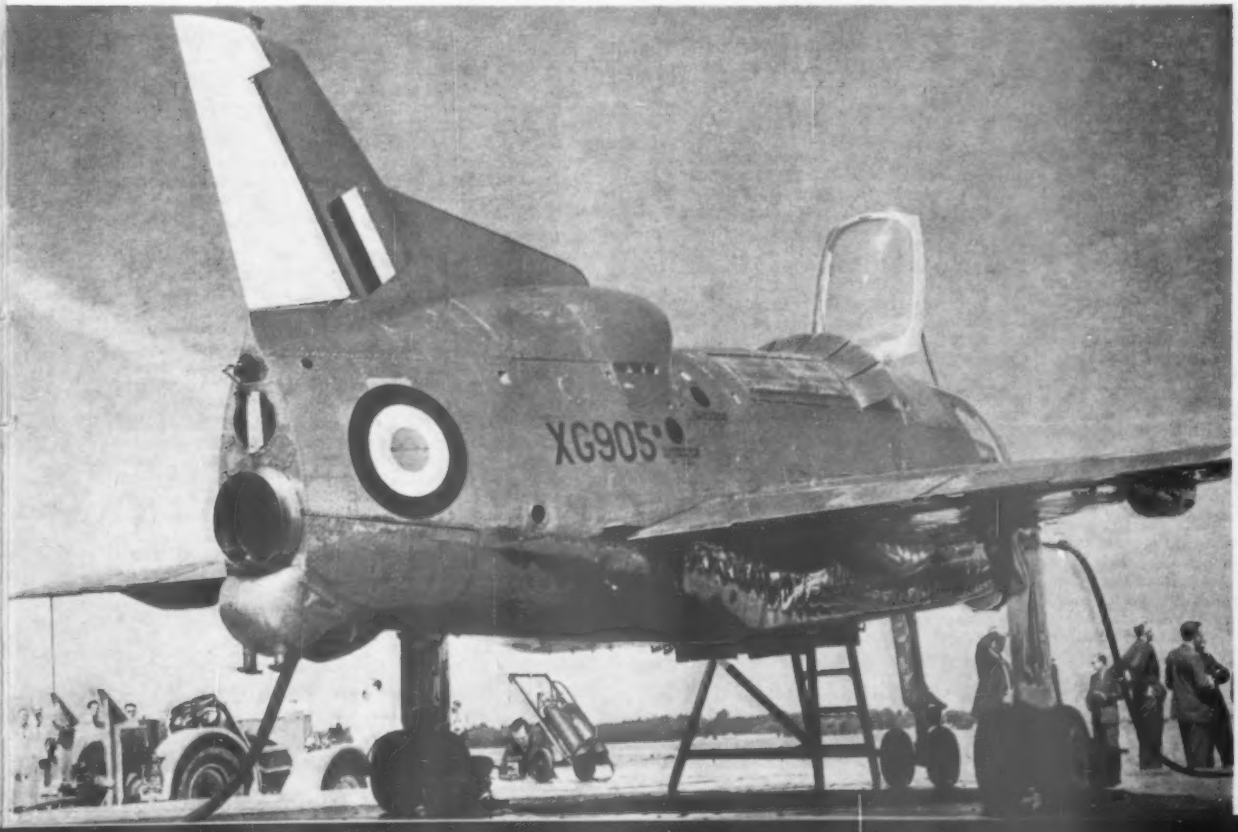
A primary control in any form of VTOL craft is, of course, that governing ascent and descent. In the SC.1 a single lever operates the lift-engine throttles for this purpose. This control, which is akin to a helicopter's collective pitch lever is raised by the pilot's left hand to increase thrust. A normal throttle on the left-hand console in the cockpit controls the thrust of the forward-propulsion engine.

Although these two engines' controls are necessarily separate, during transition it may be necessary to operate both of them together. To cater for this there is a second, twist-grip, throttle at the end of the lift lever; it is mechanically coupled to the normal propulsion throttle so that operation of either will give control of the forward-propulsion engine.

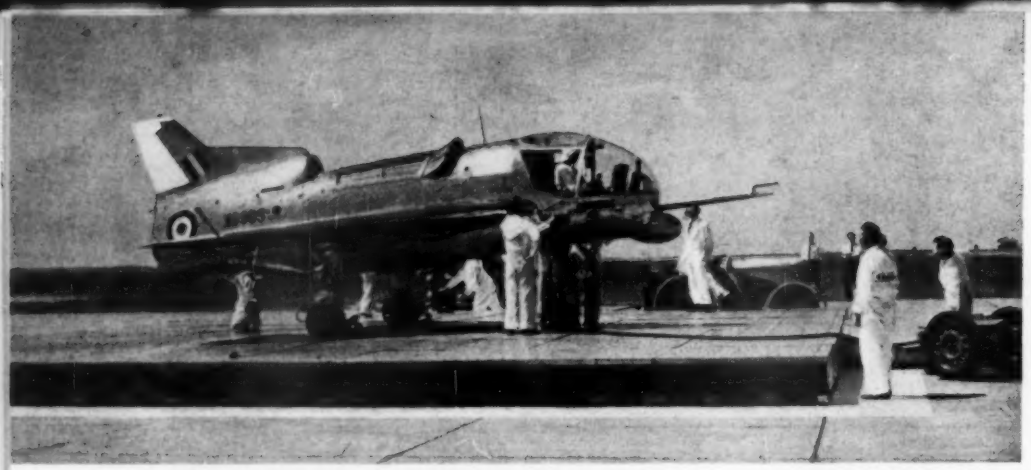
For the lift engine it is essential that there is a fast and accurate throttle response, and burner pressure control is required because a single throttle controls four engines. To meet these requirements, Hobson lightweight acceleration control units are fitted to each engine and allow the engines to accelerate independently, as well as providing extremely accurate control of the acceleration from starting speeds up to maximum r.p.m.

As already indicated, the forward-propulsion engine has its own separate intake located at the base of the fin into which it is faired by means of a large dorsal fillet. For the four lift engines there is a large common intake formed by a cut-out in the top of the fuselage over the main engine bay. Protection against the ingestion of debris when the lift engines are running with the aircraft close to, or on, the ground is provided by a 28-s.w.g. 14-mesh steel gauze screen.

One of the major problems of this sort of intake arrangement for the lift engines is that in normal forward flight such a large aperture would give rise to high drag and other unwanted aerodynamic effects. To overcome this, the major part of this intake area is covered with fore-and-aft louvres, spring-loaded to the closed position, so that when the aircraft is operating as a conventional aeroplane there is an unbroken surface beneath the protective wire mesh. These louvres will open when there is a sufficient depression in the engine bay to overcome the spring force. A smaller forward part of the



The bulbous fairing under the tailpipe for the propulsion engine is the rear jet control nozzle and incorporates two short tail-bumper legs.



Tom Brooke-Smith in the SC.1 at Bedford prepares to take-off. The 18-in. high platform has a grid centre for the lift-engine efflux and obviates temperature and ground suction effects.

intake area is controlled by power-operated gills which are normally open when the lift engines are running and closed when they are stopped.

When the aircraft is in forward flight and it is required to start the lift engines in readiness for a transition to hovering, the gills are opened. With the louvres closed, at high airspeeds this creates a sufficiently high positive pressure through the engine intakes to spin them fast enough for lift-up. At low forward speeds, when the pressure is not sufficient to spin the lift engines, starting is accomplished using air bled from the propulsion engine for this purpose.

For hovering and VTOL operation when the normal flying controls are ineffective, a "puff-pipe" system similar to that used in the Rolls-Royce T.M.R. has been adopted to provide the requisite control movements. This system is shown in some detail in the accompanying cut-away and schematic drawings. The control nozzles are located near each wing tip and at the front and rear ends of the fuselage. They are normally operated by an auto-stabilization system, but if required can be controlled manually by the pilot.

In the Rolls-Royce T.M.R., the control valves in the puff-pipes were well inboard, at the engine end. This arrangement was found to give a certain amount of time lag between the pilot's control movement and response. On the SC.1 it was decided to mount the valves at the extremities of the pipes.

A great deal of development work has gone into the system which has proved extremely satisfactory in practice. Each nozzle has a rectangular outlet form and a normal convergent/divergent cross section; the required variation in outlet area is achieved by a rotating drum within the nozzle.

From tappings on the compressor outlet casing of each of the lift engines, air is ducted through the outboard trunnion mountings of each pair and led to a central gallery duct whence it passes to the four control nozzles through smaller ducts. This nozzle feed system is made up of magnesium-alloy main ducting with cast magnesium-alloy elbows secured to the airframe. As the ducted air is hot, expansion joints are necessary and these are sealed with O-rings so that the straight ducts are pressure balanced. At normal maximum engine r.p.m. the maximum pressure in the ducting is 65 p.s.i.

In normal undisturbed hovering the nozzles are partially closed. Appropriate control forces are then given by differential operation, opening up one nozzle and closing down the other. The wing-tip nozzles give rolling control while the fore-and-aft ones, in addition to providing pitch control, are also rotated differentially by the normal rudder circuit for directional control.

Integrated Stabilization

Right from the start of the jet-lift VTOL programme, emphasis has been placed on the need for complete auto-stabilization about the pitch and roll axes. In the case of the Rolls-Royce rig, the puff-pipes control valves were linked to a duplex* auto-stabilization system using electric servo-motors to operate the valves. To give warning in the event of a failure, a fault detection system was incorporated.

For the SC.1 a more complex system was deemed to be desirable by the Short team. It was felt that in order to ensure a high degree of reliability, the auto-stabilizer should be a three-channel one in which all three are continuously working, with each capable of providing full control power, so that should one fail it can be overpowered by the other two and the control force output from the servo motors remain unimpaired.

Each channel of this "triplex" system embodies an amplifier receiving signals from control column movement to which are added stabilizing signals produced by a gyroscope. Output signals from the amplifier are fed to an electro-hydraulic servo-motor for translation into control forces that can be applied to the conventional control surfaces and to the puff-pipe nozzles. It should, perhaps, be noted that it was this dual purpose requirement, together with the need for a high response rate, which dictated the use of hydraulic servos rather than electrical ones. Although this triplex system gives a good insurance against failure, it is still necessary to incorporate a fault detection system, otherwise failures would go unnoticed.

In order that the pilot can operate both the normal aerodynamic controls and the nozzle system, when making a transition, the flying control circuit incorporates two transition units giving control selection for either or both the roll and pitch axes. There is, for example, a fully manual position giving direct control of the pitch nozzles and elevators and of the roll nozzles and ailerons to the pilot. It is also possible to have a "mixed" control with direct operation of the elevators, ailerons and rudder and the auto-stabilizer operating the roll and pitch nozzles independently. The third arrangement gives full auto-stabilizer control of the ailerons and elevators and of the roll and pitch nozzles. The rudder movement and nozzle rotation for yaw is not linked into the auto-stabilizer system and remains always directly controlled through the pilot's rudder bar.

Auxiliary power services for the electro-hydraulic systems are provided by an air turbine driven by compressed air tapped from all five engines. As the inlet air pressure to this turbine is likely to vary and as it is necessary to maintain a sensibly constant turbine speed, an hydraulically operated pneumatic throttle is built into the unit.

The hydraulic pump provides a 2,500-p.s.i. supply for the auto-stabilizer; and warning lamps are provided so that in the event of a turbine failure the pilot can revert at once to full manual control. The generator driven by the auxiliary air turbine gives a 28-volt DC supply; a 24-v. 25-amp.hr. battery is provided and, for emergency use there is a 60-amp.hr. battery.

System failures, however unlikely, have to be guarded against and emergency standby systems are always necessary. In the SC.1 the hydraulic system is not duplicated for this purpose because of the weight penalty involved. There is, however, an emergency hydraulic accumulator for the auto-stabilizer servo-motors and the elevator power control; this standby is isolated from the main system.

There is a second hydraulic accumulator for the lift-engine tilt jack. This is brought into operation by means of an emergency lever in the cockpit; in normal hovering conditions it will centralize the jack within 5° of the vertical; if the aircraft is accelerating when the emergency system is operated the engines will be swung fully forward to increase the acceleration and reduce the time taken to reach normal flight. Other emergency systems are incorporated to cater for failure at the transition control mechanisms, and wheel brakes.

Structurally, the SC.1 is comparatively straightforward, although the need to have a fuselage with the large cut-out necessary for the lift-engine intake posed some problems. The fuselage structure consists basically of four longerons on each side with closely spaced intercostal channel-section frames and a normal stringer-stabilized skin. The nose portion contains the cockpit, at the rear of which there is a sloping bulkhead carrying the guide-rails for the Martin-Baker ejector seat.

In the centre portion of the fuselage which houses the four lift engines the large cut-outs top and bottom are bounded fore and aft by titanium fire-wall bulkheads and each side by deep box beams. The bulkheads are, in fact, the front and rear spar attachment frames while the box beams carry the end loads through the engine bay. The box beams are formed by flanged diaphragms riveted between the longerons and are covered with titanium sheet which forms an inner, side, firewall. In order to accommodate the lift engines in their tilted positions these engine-bay bulkheads are "shaped" in that they slope forward and aft above and below the wing position.

In the rear fuselage there is a rearward sloping bulkhead which forms the rear wall of the propulsion-engine bay and

(*Continued on page 709*).

* Two independent "channels" operating all the time

Photo by courtesy of Flight.

THE S.C.1. IS FITTED WITH
TYRES, WHEELS AND BRAKES BY

DUNLOP

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SHORT S.C.1.

G. Q. PARACHUTE CO. LIMITED

Stadium Works, Portugal Road, Woking, Surrey.

(*Continued from page 708*)

to it is attached the main spar of the fin. Forward of this there is a vertical bulkhead which forms the front wall of the engine bay.

The fin itself is a two-spar structure with the leading-edge portion forming part of the torsion box; the dorsal fairing containing the propulsion engine intake is integral with the fuselage. The rudder structure is conventional with channel-section front and rear spars and flanged pressed ribs; it is carried on a roller bearing at the top of the fin and a torque-tube assembly in the fuselage.

With a swept-back front spar located on the 30% chord line, and a spanwise rear spar at the rear engine-bay bulkhead, the wing of the SC.1 is a fairly conventional two-spar structure. The spars have machined light-alloy angle-section upper and lower flanges and sheet webs; they do not come together at the extreme tip of the wing but are joined with a shear fitting at a point about 3 ft. inboard of it.

As a flexible bag fuel tank is housed in the inboard inter-spar portion of the wing, the drag ribs in this area have large flanged cut-outs through which is riveted an inner skin. Outboard of the tank position there is a built-up box structure of sheet diaphragms stiffened by angle and channel section members forming the main attachment structure for the undercarriage legs.

Forward of the front spar, over most of the span the leading-edge is formed by a detachable fuel tank. In the trailing-edge portion of the wing there are flanged ribs with flanged lightening holes and cut-outs for the control nozzle air ducts and for the normal flying control rods. There is a sturdy box rib at about mid-span position along the trailing-edge to provide a mounting for the twin-bearing fitting for elevator and aileron hinges. A second aileron hinge rib is located near the tip.

Elevators and ailerons are built up from channel-section

Good all-round visibility for the pilot is necessary for VTOL operation and is a feature of the SC.1.

spars and leading- and trailing-edge members with pressed flanged ribs. Each aileron is carried on roller bearings at its inboard and outboard ends. The elevators have a roller bearing at the outboard end and are supported inboard by torque tube assemblies in the fuselage.

As one would expect, the undercarriage of the SC.1 has been designed for much higher vertical descent speed than would be the case for a more orthodox aeroplane and it has an exceptionally long travel. Its most interesting feature, however, is its variable geometry.

For operation as a normal aeroplane the main-wheel position needs to be comparatively near the CG. But for vertical landings—particularly with some backward drift—such a wheel position is likely to cause the aircraft to topple over backward. This means that for VTOL operation an alternative rearward position of the main wheels has to be provided. This has been accomplished by having the main legs attached to the wing by a pin joint and providing drag bracing in the form of an hydraulic jack which can swing the leg forward or aft 15° to either one of the two positions.

Another feature dictated by VTOL requirements is the fully castoring wheels on all three legs. As this castoring capability is not required during normal take-off and landing runs, the main wheels are equipped with an automatic castor lock. This is operated by the hydraulic system used to swing the leg forward for fixed-wing take-off and landing; with the legs in this position, the wheels are prevented from castoring—when they are back for VTOL operation the lock automatically disengages and they become fully castoring. For the nosewheel there is a mechanically operated castoring lock comprising a spring-loaded plunger and Bowden cable control from the cockpit.

It is interesting that in practice to date this castoring facility has proved to be less necessary than originally thought. In fact the control characteristics of the SC.1 in vertical landings, even in severe cross-wind conditions, have been found to be precise enough for touch down to be made without sufficient sideways movement to warrant the use of castoring wheels.

In operation, the Short SC.1 gives a very convincing proof that the turbojet-powered direct-lift flat-riser is a most practical proposition. Its take-off is remarkable enough—a smooth and completely steady vertical rise to a height of about 40 ft. followed, with hardly a pause and no change of attitude, by a rapid acceleration horizontally into normal aeroplane flight. It is its landing technique, however, that makes it finally clear that the unpleasant and dangerous phenomenon of stalling has at last become aeronautically *démodé*. To see a delta aeroplane make a normal swift circuit of an aerodrome, approach the runway quite fast, slow down, stop, and descend vertically to a gentle touch-down, adds a certain amount of point to the use of the word "breakthrough" that has been used in relation to craft of this sort.

As we said earlier, however, at the present state of the art, the SC.1 is no more than a research vehicle. With the new generation of Rolls-Royce jet-lift engines—which are reported to have half the weight of the RB.108 for the same thrust—this technique could certainly be put to good military use in a supersonic VTOL fighter in the foreseeable future. Indeed, one of the many projects studied by the Short team is an attractive compound delta with six lifting engines and one forward-propulsion unit, the intakes for the latter being in the wing root. This, clearly, is a somewhat forward-looking project, and the company has other shorter-term possibilities in mind in the form of straight developments of the SC.1 with improved versions of the present engines.

In fact, the most pressing need at the moment would seem to be the accumulation of "user experience," so that the pure operational problems as well as those related to the reliability and serviceability of a radical vehicle can be investigated "in the field." There is, indeed, much to be said for building a small number of improved SC.1s for exploratory operation in the R.A.F.

On the civil side of the VTOL picture, the prospect is inevitably a longer-term one. The indications are, though, that the Short VTOL integrated system technique is now at least as far—if not more—advanced as the technologies related to civil supersonics. Noise and economy are, perhaps, the largest problems still to be overcome and in this the Rolls-Royce team—with their unrivalled experience with the RB.108 and a long background of research and development into jet-lift engines—will doubtless come up with an appropriate solution. Some form of fan engine perhaps would be the long-term answer in that it would be quieter and more economic in terms of fuel consumption.

Seven years ago Dr. A. A. Griffith of Rolls-Royce, propounded his solution to the problems posed by a coming demand for supersonic airliners with a slim delta airframe and special jet-lift engines separate from propulsion engines. The Short SC.1 has taken the realization of that "dream" a sizeable step forward.—F.T.M.

A close-up of the rear fuselage. A tail parachute is stowed in the compartment above the jet pipe.

The Fighting Services

Change of Command

AIR VICE-MARSHAL A. D. SELWAY, C.B., D.F.C., is to become Commander-in-Chief, Far East Air Force, at the end of this month with the acting rank of Air Marshal. He will succeed Air Chief Marshal The Earl of Bandon, K.B.E., C.B., C.V.O., D.S.O., who has held the appointment since July, 1957.

Air Vice-Marshal A. D. Selway.

Air Officer Commanding, No. 18 (Reconnaissance) Group, Coastal Command, and Senior R.A.F. Officer, Scotland, since September, 1958, Air Vice-Marshal Selway was previously Commander, R.A.F. Staff, British Joint Services Mission (U.S.A.) from November, 1955. From 1953 to 1955 he was Air Attaché in Paris.

The appointment of A.O.C., No. 18 Group, is to be taken over by Air Cdre. R. B. Thomson, C.B., D.S.O., D.F.C., on Jne. 24 with the acting rank of Air Vice-Marshal. A.O.C., Gibraltar, since May, 1958, Air Cdre. Thomson was previously Group Captain in charge of Operations at Headquarters, Coastal Command.

Lightship Rescue Award

THE Alan Marsh prize instituted by the Helicopter Association of Great Britain (now the R.Ae.S. Rotorcraft Section) in recognition of outstanding rotary-wing pilotage has been awarded to Flt. Sgt. B. Breach of No. 228 Squadron, Coastal Command, based at R.A.F. Leuchars. He receives the prize for piloting the helicopter which last December rescued five of the crew of the gale-battered North Carr Lightship, then in imminent danger of foundering.

Called in following the loss of the Broughty Ferry lifeboat with all hands, Flt. Sgt. Breach flew to the lightship in a Sycamore. Hovering over the ship the helicopter winched up two of the crew and flew them to the shore; returning, it took off three more, including the captain. The entire operation from the moment the helicopter took-off until the last man was landed lasted 1 hr. 33 min. A second helicopter of No. 288 Squadron, piloted by Flt. Lt. J. E. McCrea, stood by during the operation and then rescued the two remaining members of the crew.

Flt. Sgt. Breach will be presented with his prize at the Rotorcraft Section's annual dinner at the Dorchester Hotel in September.

Gunnery Champions

DURING his recent two-day visit to the R.A.F. in Germany, H.R.H. the Duke of Gloucester presented the Duncan Trophy to No. 26 Squadron, the 1959 winners of the annual 2nd T.A.F. air-to-air gunnery competition. Commanded by Sqn. Ldr. D. L. Edmonds, A.F.C., the Squadron forms part of No. 121 Day Fighter Wing with Nos. 20 and 14 Squadrons at R.A.F. Gutersloh.

Achieving a 10% better average than the next best Hunter squadron during the competition, No. 26 Squadron had no avoidable gun stoppages nor were any other servicing penalties incurred—a high tribute to the ground crew. Altogether, No. 26 won the trophy for 1959 against keen competition from four other Hunter day-fighter squadrons, two Javelin all-weather squadrons and two Meteor night-fighter squadrons.

The Duncan Trophy was originally presented to the R.A.F. in 1944 by General Duncan, then Chief of the Brazilian Air Force, to mark the bond of friendship between the two air forces. In 1953 the trophy was handed over for competition to the 2nd T.A.F. in Germany and has been awarded annually since then to the squadron achieving the best gunnery results.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. A. S. R. Strudwick, D.F.C., and Wg. Cdr. A. R. Wilson, D.S.O., to the Department of the Chief of the Air Staff; Wg. Cdr. W. D. Evans, D.F.C., to the Department of the Air Member for Personnel.

Bomber Command: Wg. Cdr. P. G. Hill to R.A.F. Marham to command No. 214 Squadron; Sqn. Ldr. K. O. Lockyear to R.A.F. Lindholme as Senior Technical Officer, with acting rank of Wg. Cdr.

Fighter Command: Sqn. Ldr. R. E. Gardiner, D.F.C., to R.A.F. Leconfield to command No. 72 Squadron, with acting rank of Wg. Cdr.

Coastal Command: Wg. Cdr. K. H. P. Murphy, M.B.E., to R.A.F. Aldergrove to command the Administrative Wing; Wg. Cdr. R. S. B. McClean to Headquarters as Deputy Principal Medical Officer.

Transport Command: Wg. Cdr. G. W. Swanwick to Headquarters for organization duties.

Maintenance Command: Wg. Cdr. D. C. Goodrich to Headquarters, No. 41 Group, for engineering duties; Wg. Cdr. A. H. Mawer, D.F.C., to the R.A.F. Staff College, Andover, for directing staff duties; Sqn. Ldr. R. H. Petchey to the R.A.F. Staff College, Andover, for directing staff duties, with acting rank of Wg. Cdr.

R.A.F. Germany: Wg. Cdr. N. Poole to Headquarters as Deputy Senior Personnel Staff Officer.

Far East Air Force: Wg. Cdr. F. H. Kelly, M.B.E., to Headquarters for equipment duties.

Other Appointments: Gp. Capt. D. S. Wilson-MacDonald, D.S.O., D.F.C., to Stockholm as Air Attaché; Gp. Capt. B. P. Young, O.B.E., to A.F.C.E. for staff duties; Wg. Cdr. C. F. Ambrose, D.F.C., A.F.C., to Belgrade as Air Attaché, with acting rank of Gp. Capt.; Wg. Cdr. D. S. Grant to Headquarters, 2nd A.T.A.F. as Medical Adviser, Logistics; Wg. Cdr. D. J. Lynch, M.B.E., to A.A.F.C.E. for administrative duties; Wg. Cdr. J. S. Mason to the British Joint Services Mission, Washington, for liaison duties; Wg. Cdr. J. H. T. Pickering to A.A.F.C.E. for operational duties; Wg. Cdr. R. E. G. Piff to the Ministry of Aviation; Wg. Cdr. B. Spray to A.A.F.C.E. as Personnel Staff Officer to the Commander; Wg. Cdr. A. McK. S. Steedman, D.F.C., to the Joint Services Staff College for directing staff duties; Sqn. Ldr. A. J. M. Morgan to the Ministry of Aviation with acting rank of Wg. Cdr.; Sqn. Ldr. J. T. Prentice to the War Office with acting rank of Wg. Cdr.

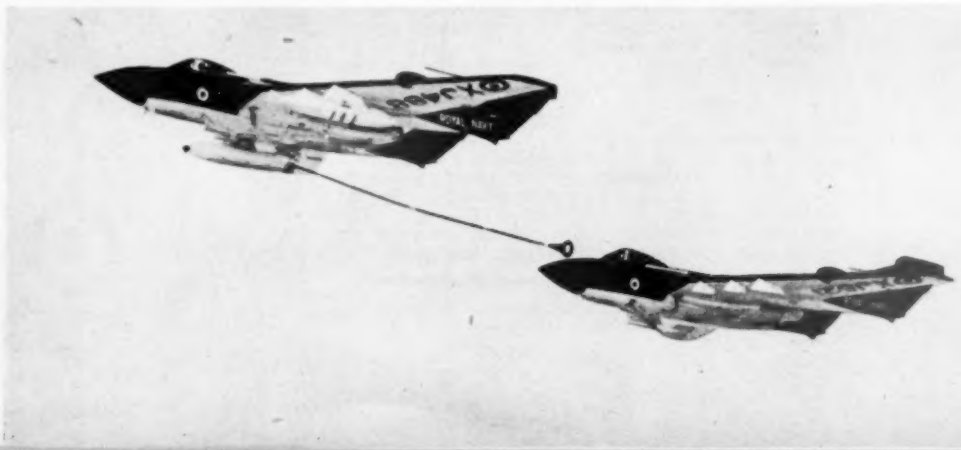
More Service News

Hack Trophy.—Manchester University Air Squadron won this year's Hack Trophy competition held at the R.A.F. Central Flying School, Little Rissington, on May 28. Out of a possible total of 540 points, Manchester scored 354.5 points; London U.A.S. obtained 349.5 points; and Glasgow U.A.S. came third with 264.5.

Biggin Hill Reunion.—A reunion will be held in London next September for all who served in the Operations Room at R.A.F. Biggin Hill during 1940. Anyone eligible and interested in attending are invited to write to Warrant Officer E. T. Pierce at 115 Priory Crescent, Aylesbury, Bucks.

R.A.F. West Malling.—The U.S. Navy is to take over administrative and operational control of R.A.F. West Malling in October. The station will be occupied by the U.S. Navy Transport and Communications Squadron previously based at Blackbushe.

R.A.F. Benevolent Fund.—Contributions to the R.A.F. Benevolent Fund resulting from the 1959 "Battle of Britain Week" activities by R.A.F. Association branches show an increase over the corresponding figure for the previous year. £15,364 has now been received from 328 R.A.F.A. branches compared with £14,624 from 341 branches over the similar period in 1958.



INCREASING RANGE—Two D.H. Sea Vixens just prior to making contact during a recent buddy flight-refuelling trial undertaken by de Havilland at Hatfield. All operational Sea Vixens can become tankers with the attachment of the self-contained refuelling pod to the starboard outer pylon.

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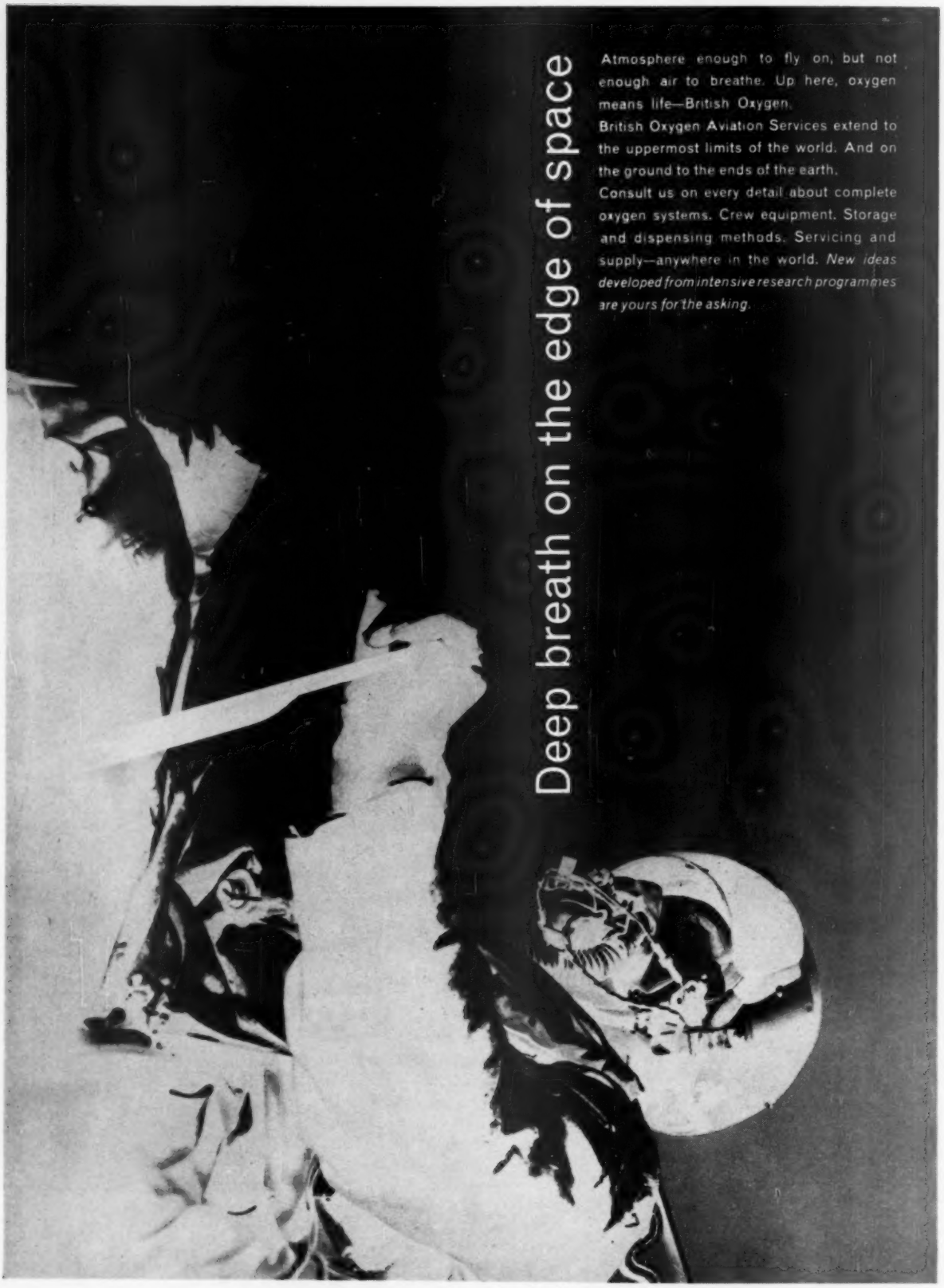
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Aviation News in General

BIRTHDAY FLYPAST. — Sixteen Fighter Command Hunters are to fly over Buckingham Palace at 13.00 hrs. tomorrow (Jne. 11) to mark the official birthday of H.M. the Queen. Led by Wg. Cdr. G. J. Storey, O.C., Flying, Duxford, the fighters will be drawn from Nos. 19, 56, 65 and 66 Squadrons.

FAST RETURN.—The Bomber Command Valiant of No. 214 Squadron which flew non-stop from the U.K. to Singapore in 15 hr. 35 min., made the return trip from Butterworth, Malaya, to R.A.F. Marham in 16 hr. 16½ min. Flying against head winds, it was again flight refuelled over Karachi and Cyprus by Valiant tankers.

B-58 TRAINER. — The first Convair TB-58, trainer version of the B-58, made its maiden flight recently and is scheduled for delivery to the U.S.A.F. on Jne. 30. This aircraft will be used for transition and instrument training of B-58 pilots; it does not have the bombing and electronic counter-measures equipment of the operational aircraft.

NA.39 ESCAPE.—Rocket-sled tests at China Lake, California, have proved that high-speed low-level ejections can safely be made from the Blackburn NA.39 strike aircraft. Through-the-canopy ejections will be possible.

NUCLEAR BOMBER?—According to the U.S. Defense Dept., test flights with nuclear-powered aircraft should be made in the "mid-1960s," but an operational aircraft is further off in time. In the past 14 years the U.S. has spent about £357 million on its programme to develop nuclear propulsion for aircraft.

U-2 MEDALS.—According to *Soviet News*, "officers and men who distinguished themselves in shooting down the American spy plane on May 1 were presented with government orders and medals" at a ceremony in Sverdlovsk on May 19.

AMERICAN BREAK-THROUGH.—United Airlines have ordered a Caravelle flight simulator with full motion in pitch and roll, from the Flight Simulator Division of Redifon, Ltd. When completed it will be installed in the airline's training department at Denver, Colorado. Redifon are also supplying a Comet 4 type trainer with motion in pitch only to C.M.A. Mexican Airlines.

DOPPLER ORDER.—An order for eight CMA-601 navigation computers has been placed with the Canadian Marconi company by K.L.M. together with a repeat order for four CMA-623 Doppler Sensors. K.L.M. DC-8s are the first delivered by Douglas with complete Doppler equipment ready for operational use.

BIG RADAR.—First Ballistic Missile Early Warning System (BMEWS) site at Thule, Greenland, is expected to be operational this autumn. First operational tests may use polar orbiting satellites as "targets."

NUCLEAR BOOST.—A sub-orbital test vehicle for the Project Rover nuclear rocket has been proposed by the Martin Company, utilizing a modified Titan first-stage.

PIONEER FADES.—Power drain of the 150-W. transmitter in the solar probe, Pioneer V, has proved too much for the storage batteries which have apparently deteriorated. However, Jodrell Bank is still receiving data via the 5-W. transmitter which should remain effective up to about 20 million miles. It was hoped that the higher-power transmitter would provide a radio range of some 50 million miles.

COMMUNICATOR. — First Courier delayed-repeater communications satellite is scheduled for launching on or about Sept. 1.

SUPER BOOST.—Rocketdyne expect to test the first complete 1.5 million lb. s.t. F-1 rocket engine at Edwards Air Force Base, California, next spring.

MORE Tu-114 RECORDS.—A further series of records has been claimed for the Tu-114 following a flight with a 25-tonne (55,116-lb.) payload over a 5,000-km. (3,107-mile) circuit at 544.7 m.p.h. The flight breaks the existing F.A.I. records for this distance with payloads of 1, 2, 5, 10, 15 and 20 tonne also.

VISCOUNT PURCHASE.—Maitland-Drewery Aviation has purchased three Viscount 708s from Air France. The aircraft, which have a 49-seat layout, arrived at Gatwick at the end of last week and are immediately available for group charters in the present season.

BIG VTOL.—A VTOL airliner with twelve turbojet engines has been proposed by Mr. James O'Malley, technical director of Bell Aircraft Systems division; the craft would be about the size of a Boeing 707.

LONDON-SHANNON. — Air Lingus opened a direct London-Shannon service on May 30 with Viscounts. There is a daily service and a weekly all-freight service on this route.

L.A.P. MOVE.—The apron at London Airport North is now being supplemented by the B.O.A.C. maintenance area at Cranford Lane. This area is used by aircraft of B.O.A.C. and of other companies handled by the Corporation when the apron is full or when a quick turn-round, requiring 3½-5 hr. of servicing and maintenance, is wanted. Passengers and baggage are transported to or from the North Side Terminal for processing.

HERALD BACK.—The first production Handley Page Herald arrived back at Woodley on May 27 at the end of its 34,000-mile tour of Africa and South America. A large part of the time was spent in Brazil where the prototype Herald was demonstrated during 1959. Orders for the Herald are "expected before the end of the year," according to Handley Page.

SHEREMETYEVO OPENS. — Since Jne. 1, all international services into Moscow have been using the new airport at Sheremetyevo some 20 miles from the city centre. The former international airport at Vnukovo is now used only for internal services and an air link is provided between the two airports for transit passengers.

B.U.A. BEGINS. — Following the incorporation of British United Airways on May 20, services are now being operated from Gatwick in the name of this new company. The routes and aircraft are those of Airwork, Transair, Morton and Olley—all at present carrying their former liveries. Other B.U.A. services operate from Southend and Stansted.

DC-8 ORDERS.—United Airlines has changed its DC-8 order to include 22 of the JT3C-powered Series 10 domestic version, 15 domestic JT4A-powered Series 20s and three Series 50s with JT3D turbofan engines. The Philippine Air Lines' order for two DC-8s has also been changed from Series 30 to Series 50 versions with turbofans.

C.A.I. PRESIDENT. — Mr. David Boyd, O.B.E., B.Sc., F.C.A.I., formally took office as President of the Canadian Aeronautical Institute for 1960-61, at the Institute's annual general meeting on May 14. He is works manager of Rolls-Royce of Canada, Ltd., in Montreal.

CANADIAN APPOINTMENT.—Mr. Victor Koby has been appointed a director and general manager of Field Aviation Co., Ltd., of Oshawa, Ottawa, Toronto and Calgary. Mr. Koby was formerly with Field's parent company, Hunting Associates, Ltd.

ANOTHER BUYER.—Sweden is the tenth country to buy English Electric Canberras. Here a Swedish Canberra T.Mk.11, an A1 radar trainer, is seen at the company's airfield at Samlesbury prior to delivery.

Anglo-Belgian Collaboration

One of the three basic military aircraft types received for overhaul at Gosselies is the Hawker Hunter. Nearly 200 of these had been assembled by Avions Fairey by the end of 1958.

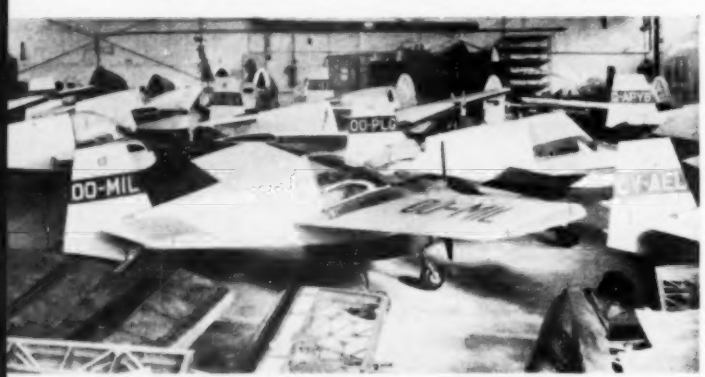
PRODUCTION by Avions Fairey S.A. of the Lockheed F-104G Starfighter is to begin at Gosselies, Belgium, in the autumn. This company is, as is widely known, a subsidiary of the Fairey Co., Ltd.

The Belgian aircraft industry comprising Avions Fairey and SABCA (Société Anonyme Belge de Constructions Aéronautiques) will co-operate with the South German Group (composed of Messerschmitt, Dornier, Heinkel and Siebel) to manufacture some 400 aircraft under Lockheed licence. The Dutch industry will work in conjunction with the North German Group (Hamburger Flugzeugbau, Weser and Focke-Wulf) for a similar quantity. In all, nearly 800 Starfighters are to be built, following the agreement signed last March between the Defence Ministers of Belgium, the Netherlands and West Germany.

Major sub-assemblies are to be built at Gosselies and, in addition, Avions Fairey will be responsible for some final assembly and test flying.

Gosselies is, at present, fully occupied with contracts from the Belgian and French Air Forces for the overhaul of their standard fighter aircraft.

After two years' service, and irrespective of the number of hours they have flown, Republic F-84F Thunderstreaks of the Belgian Air Force are brought to Gosselies for an IRAN—initials pronounced as a word and signifying "Inspect and Repair As Necessary." Each aircraft is first stripped down to its component parts and then the individual components are stripped, tested and checked. Liquid oxygen regulators, gauges and converters, guns, radio and radar sets, hydraulic power controls, wheels, brakes, generators, inverters, fuel pumps and measuring equipment—each of these items is taken from the aircraft, completely dismantled and checked and faulty components replaced. When the aircraft leaves it is considered as having a new life.



One hangar is devoted to production of the Fairey Tipsy Nipper of which 80 had been sold by the end of May.

Left, Republic F-84F Thunderstreaks of both the Royal Belgian and French Air Forces are overhauled at Gosselies.

Three basic types of aircraft are received from two military air arms. They are Republic F-84Fs, Hawker Hunter Mk. 6s (most of which were originally assembled at Gosselies during 1955-59 from parts manufactured by Hawker and Fokker) and Hunting Pembrokes from the Royal Belgian Air Force and F-84Fs from the French Air Force.

The Belgian F-84Fs have the most detailed overhaul. Those from the French Air Force are maintained and repaired to an official schedule which does not demand quite the same degree of maintenance of equipment. The Belgian Hunters are also overhauled to a shorter schedule but, in addition, they are returned to Gosselies in rotation for various modifications. The Pembrokes, used by the Belgian Air Force for aerial photography, communications and multi-engine pilot training are repaired and maintained, and are occasionally brought in for conversion to different rôles such as V.I.P. transport.

Belgian F-84Fs for IRAN are flown in by air force pilots; those that have had ground failures or have crashed are brought in by road. An incoming check is made on the hard-standing in front of the main repair hangar for functional testing of main services and systems, and the engine has a test run. The aircraft is then taken to a flight shed for paint stripping and cleaning down. It is then returned to one of the two double bays in the No. 1 hangar. One of these is reserved for Belgian F-84Fs and the other for French F-84Fs and Belgian Hunters.

Then the aircraft is dismantled completely. The rear fuselage is removed and the engine withdrawn; complete undercarriage, flaps, elevators, spoilers, ailerons, pylons, dive brakes, fuel tanks, inspection panels, radar, radio, navigation aids, guns, radar-ranging equipment, instruments, control runs, hydraulic hoses, generators, inverters, starter bottle, cowlings, fairings, ejection seat, flying tail, gun deck, canopy—everything that is removable is taken off at this first stage. All that is left is a skeleton front fuselage with wings attached and a rear fuselage with the small part of the fin below the tailplane which is of integral construction.

Each complete major component is inspected for major faults and, after agreement with Belgian Government inspectors on the spot, a quadruplicate order for replacement parts is passed through to the Works Office. This first examination is only to weed out those major components which are beyond repair.

The items are passed on to their respective servicing bays where they are completely dismantled. The Avions Fairey inspectors then decide which new part must be ordered from the manufacturers to bring the component to the approved condition.

One bay is devoted to ejection seat repair. The seat used in the F-84Fs is Republic-built; that in the Hunters is built by Martin-Baker. Linkage, cabling, release units, cartridges, firing mechanism, hood and harness are stripped, checked, reassembled and freshly painted.

For engine repair there are two separate bays, one for the

General Electric J65 (many of them Buick built) for the F-84Fs and the other for the Hunters' Rolls-Royce Avons, practically all of which are the Mk. 203 version built under licence by the Belgian Fabrique Nationale factory at Liege. Engine inspection and overhaul is of a minor nature compared with the work done on other components. Certain engine-driven accessories such as hydraulic pumps and generators are given a major treatment, but only standard maintenance tasks are performed on the engine itself. At the end of every 600 hours the engine is returned to the manufacturers.

Components tested include the Republic-designed hydraulic power control units for the F-84F; the standard Hydrobooster for the Hunter built by Fairey's Hydraulics Division at Hayes; the Maxaret brake control units; and the high-pressure compressor for charging starter bottles. The F-84F starter bottle is a sphere of spun glass-fibre lined with steel sheet. After checking for capillarizing and flaws in the glass-fibre covering, pressure is applied to 3,500 p.s.i. while the sphere is contained in a wire cage. This not only contains fragments in the event of an explosion but, by fitting very closely, also indicates if the bottle is expanding under pressure.

The IRAN for the French F-84Fs is done to a slightly less stringent French Air Force schedule which means that French F-84Fs "turn round" in about three months compared with four and a half months for Belgian aircraft. Since 1959 Gosselies has handled some 80 F-84Fs from Belgium, 40 from France and 60 Belgian Hunters.

In the main Engineering and Design Block is an Instrument Repair Laboratory, with test installations constructed by Avions Fairey in conjunction with Bryans Aeroquipment. These are capable of testing liquid oxygen regulators and gauges in addition to standard instruments such as altimeter, airspeed indicator, Machmeter, direct-reading pressure gauges and time flight clocks. Previous to the completion of this installation some six months ago liquid oxygen regulators had to be returned by the Belgian Air Force to the manufacturers. Radar installations, VHF, UHF and IFF transmitter/receivers are also overhauled and checked in this laboratory as are gyroscopic instruments, but only minor repairs and adjustments are undertaken.

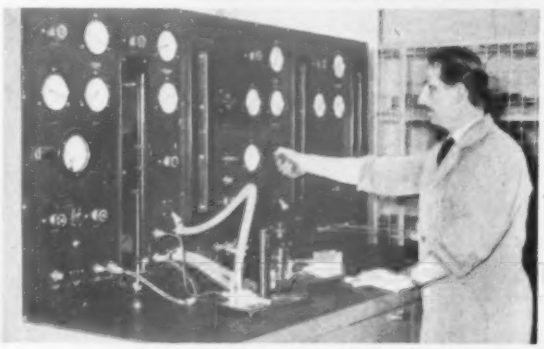
A small design section has responsibility for support equipment such as test and re-alignment jigs, tools and cradles, and for structural modifications. Both the Belgian and French Air Forces supply complete modification kits for their F-84Fs.

Jigs for structural repairs on the F-84F are specially designed and built; those for the Hunter are adapted from the original jigs which Avions Fairey used in the assembly of some 192 Hunters for the Belgian Air Force during 1955-58. Most of these are now returning for the standard IRAN.

Above, jigs for structural repairs are specially designed at Gosselies. Here a fixture is being checked.

Above, a section of the aircraft bonded stores.

Right, an instrument under test in the fully equipped laboratory.



Above, overhaul of hydraulic equipment is a speciality of Avions Fairey.

In the Main Reassembly Hangar the gun packs for the Hunter and F-84F are stripped, checked and aligned; radome caps stripped and cleaned and 32 separate coats of controlled-thickness rubber solution sprayed on, undercarriages assembled and aligned; and structural components and skins repaired and fitted.

Without the original construction jigs to work with, great care has to be taken in the case of the F-84F to avoid deformation in an item as large as a wing section. Rivets and panels are removed progressively in sections to reduce twisting and bending loads to a minimum. New skins are stretched and drilled before being offered up to the component, and the headaches involved here can be gauged from the fact that in one skin for an aileron there are some 700 holes which have to be drilled in the new plate (26-gauge) to match exactly the existing holes in the structural member.

The paint shop is probably one of the best of its kind in Europe—certainly far in advance of the average aircraft industry painting facilities and comparable with the best automobile factory practice. It is divided into two bays, one for synthetic paints and the other for the cellulose used on Hunters and Nippers. All stencilling is done in English, the standard language for N.A.T.O. forces. An interesting contract also fulfilled in the paint shop is the modification of fuel bowsers for Shell.

After ground test runs an Avions Fairey test pilot takes the machine up for a full flight test and the aircraft is returned to the air force in new condition. The average number of flights needed to check out a Thunderstreak from Gosselies is 2.1.

Production of Avions Fairey's own aeroplane, the Tipsy Nipper, is carried through in one hangar except for painting. This little machine now looks like being the biggest success in Avions Fairey's long line of famous private aeroplanes developed by Mr. E. O. Tips. By the end of May, 1960, over 80 Nippers had been sold to clubs and private owners in the U.K., Germany, Austria, Netherlands, Switzerland, Denmark, Sweden, Ghana, Nigeria, Puerto Rico, U.S.A., Australia, South Africa, Italy and Sierra Leone. Although it is the dual ignition version which has been given a British C. of A. the single-ignition aircraft still has many adherents, particularly in Germany, and 10% of the Nippers sold have single ignition.

The entire construction is done at Gosselies, including the production of kits. After assembly the aircraft are test flown by Avions Fairey's senior test pilot, M. Bernard Neefs and his colleague M. Jacob de Beuken.

With Nippers, Hunters, Pembrokes, F-84Fs and, in due course, Starfighters, a day's flight testing at Gosselies is likely to be as varied as at any aircraft manufacturer's airfield in the World.

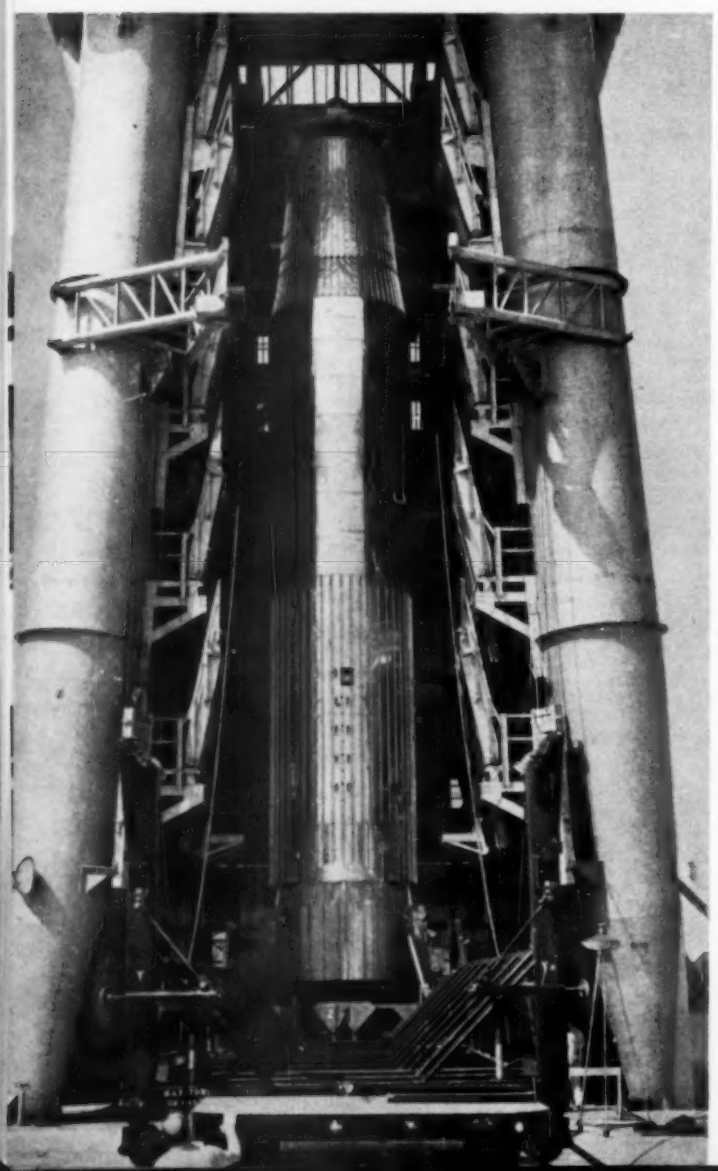
Missile into Satellite Launcher

WITH the recent cancellation of the Blue Streak LRBM Britain has opted out of the development of long-range missiles; these are now produced only by Russia and the U.S. But although Blue Streak is dead as a strategic missile, it is the only vehicle on which Britain can base an effective space programme, either military or civil. Studies of the cost and value of such a programme are now being made and, after considering these, the Government will make a final decision about Blue Streak's future.

Recent indications of the military value of satellites, and their undoubted value for scientific studies, suggest that it would be unwise to decide against a British satellite programme. Blue Streak would be an ideal basic booster for this. Its large size and liquid-fuel propulsion are both advantages for a satellite launcher, although these are features which count against it from a military viewpoint.

Blue Streak was scheduled to enter service in 1965; long before then the U.S. plans to have the Minuteman ICBM and Polaris IRBM in service. Both these are solid-propellent missiles of smaller size than Blue Streak, though with smaller warheads.

Until recently the Blue Streak programme was highly secret and even now detailed information about this missile cannot be given by the companies concerned in its development. But, as so often happens, many facts about the missile have been revealed in Parliament, particularly during the recent Blue Streak debate.



BASIC BOOSTER.—Blue Streak compares in size more with the Atlas ICBM than with the U.S. IRBMs. Its relatively high thrust is an advantage for launching satellites.

Blue Streak is designed for launching over a range of 2,500 nautical miles from hardened underground sites which are intended to protect it from enemy attacks. The prime contractor, de Havilland Propellers, Ltd., designed the missile in collaboration with Convair, drawing to a considerable extent on U.S. experience with the Atlas ICBM. The two-chamber liquid oxygen/kerosene rocket motor for the missile has been developed by Rolls-Royce Ltd., under an agreement with Rocketdyne; it is based on a Rocketdyne motor. The inertial guidance system has been the responsibility of Sperry.

Before deciding to develop Blue Streak, the Government investigated the possibility of obtaining, from the U.S., a suitable ballistic missile to succeed the V-bombers. In June, 1954, Mr. Duncan Sandys, who was then Minister of Supply, visited the U.S. to discuss this, but at that time it was not U.S. policy to supply other countries with ballistic missiles, even without their nuclear warheads, because this was considered contrary to the spirit of the McMahon Act. However, the U.S. did agree to give full technical assistance for the development of a British missile, although not for its warhead.

When Mr. Sandys became Minister of Defence in 1957 he called for a review of military developments, which led to the famous Defence White Paper of that year. One major point to be decided was the weapon to succeed the V-bombers as the vehicle for the nuclear deterrent. The choice lay between Blue Streak and the supersonic bomber under development by Avro. The bomber was cancelled.

When the McMahon Act was amended in July, 1958, an exchange of nuclear information became possible; up until that time Britain did not possess the technical information needed to design warheads suitable for fitting to U.S. weapons. This created a new situation and Mr. Sandys visited Washington to see whether Britain could substitute a suitable U.S. weapon for Blue Streak and thus save money.

The only U.S. missiles in the medium-range field were Thor and Polaris. Thor was rejected as a replacement for Blue Streak because it did not have the necessary range and could not be sited underground. At that time the under-water launching of Polaris created many problems, and the U.S. authorities advised that Britain would be unwise to cancel Blue Streak until the feasibility of the Polaris system had been proved. It was also suggested that Britain would do better to wait for a later and improved version of Polaris.

Apart from this advice it was clear that Britain could not produce the necessary nuclear submarines before 1970 and that as a result the country would be without a deterrent for several years after the V-bombers with stand-off bombs became obsolete. To buy the submarines from the U.S. would have been exceedingly expensive even if it had been possible to do so.

In the past year or so the demonstrated accuracy of Russian space launchings and missile firings cast doubts about the advisability of Britain having a fixed-site missile. A hint of this was given in the 1960 Defence White Paper, which said "The possibilities of mobile launchers, whether aircraft or submarines, for long-range delivery of nuclear warheads, are being investigated."

Only a few weeks later, in April, Mr. Watkinson announced the cancellation of Blue Streak. The main reasons given were the increasing vulnerability of missiles launched from fixed sites and the practicability of launching long-range missiles from mobile platforms. It also stated that: "On present information there appears much to be said for prolonging the effectiveness of the V-bombers by buying supplies of the airborne ballistic missile Skybolt which is being developed in the United States."

More details were given by Mr. Watkinson after this statement and in the later Blue Streak debate. Cancellation of the missile was likely to cost about £100 million; if it had gone into service the total cost would have been £500 to £600 million. Little

(*Continued on page 715*)

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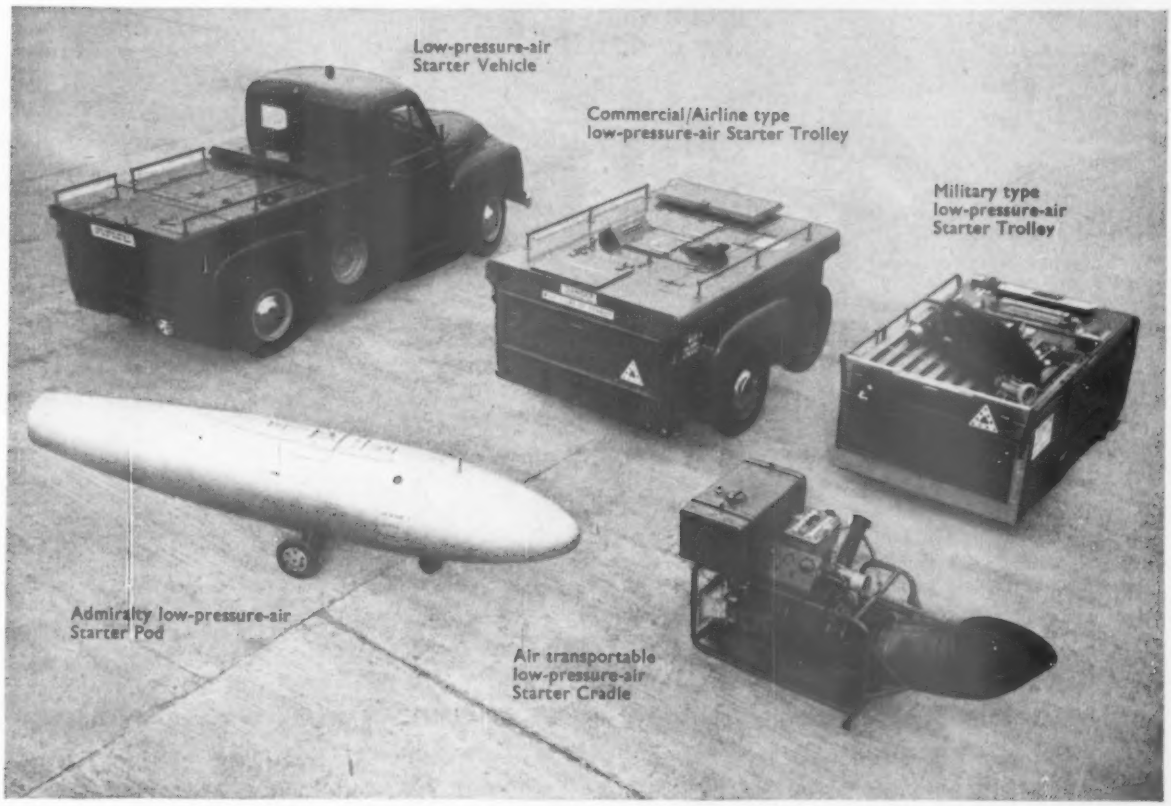
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SURVIVAL, FOR US AS FOR THE CHAMELEON, DEMANDS VERSATILITY

A chameleon can always adapt itself to the prevailing conditions—and to this versatility it owes its survival. The same principle applies in modern warfare. A defence system which is flexible in operation is less likely to be defeated than one which is not.

A MISSILE THAT DOES TWO JOBS

Thunderbird can be used in two ways. It can be used efficiently in a static role operating from a preselected site for as long as it is tactically required there. But should some new threat arise—and attack seldom hits us where we are expecting it—Thunderbird can be moved easily and quickly, on wheels or by air, and re-deployed in a few hours wherever it is most needed.

Thunderbird is thus unique. It can be used in both a static and mobile role.

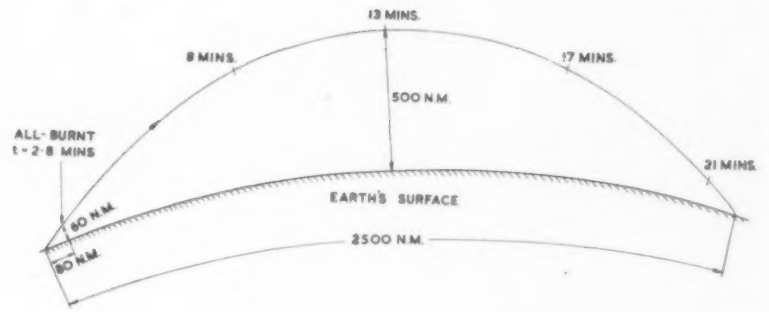
NEW DEVELOPMENTS

Thunderbird has passed all its acceptance trials and is now in service with the Army. But evolution goes on. The successor to Thunderbird is now completing its development. Using the latest techniques and retaining its full mobility, the new version will provide, among other things, better performance against low-level attack and longer range.

'ENGLISH ELECTRIC' THUNDERBIRD

ENGLISH ELECTRIC AVIATION LIMITED · *GUIDED WEAPONS DIVISION* · LUTON · STEVENAGE · WOOMERA

GW26



TRAJECTORY.—As a missile Blue Streak would have projected its warhead over a trajectory of this type.

(*Continued from page 714*)

of the money spent will have been wasted if a space programme is based on Blue Streak. The technical merit of the missile has never been disputed.

Although not already stated in Parliament, it appears that the project has been cancelled at a stage when the country would have been committed to considerable expenditure if development had continued. Test firings were due at Woomera this year, and in addition it is probable that work on the complicated and costly launching sites would have been started soon.

Following this cancellation, work on the project has come almost to a standstill pending a decision on the use of Blue Streak as a satellite launcher. Such a programme might well involve up to £50 million a year; nevertheless, opinion appears to favour it. The military value of a British satellite programme will probably be the deciding factor.

As we have already said, little official information has been released about Blue Streak, but photographs of the missile have been published. And there have been photographs also of models of a satellite-launcher version in which Black Knight acts as a second stage.

A large single-stage missile, Blue Streak probably has a launching weight of about 200,000 lb. Its twin-chamber lox/kerosene rocket motor apparently delivers a thrust of around 250,000 lb. and has a burning time approaching three minutes.

In physical size Blue Streak is more akin to first-generation U.S. ICBMs such as Atlas than to the IRBMs. Complete with nose-cone it is about 70 ft. long and 10 ft. in diameter.

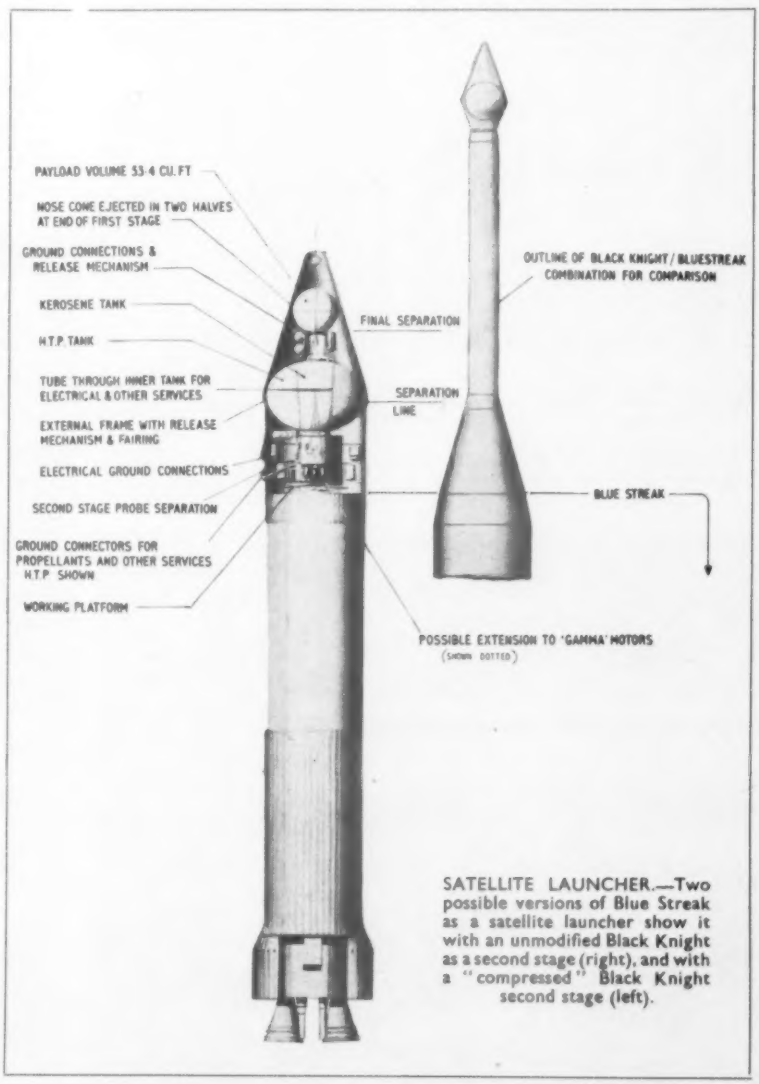
Undoubtedly its large size reflects the choice of a single-stage missile although it was intended to deliver a warhead over 2,500 n.m. This warhead was obviously a substantial one, and Mr. Sandys has referred to Blue Streak's ability to carry decoys as well as the warhead.

Choice of warhead size is decided both by the state of a country's nuclear technology and by the guidance accuracy anticipated. At the time that Blue Streak was ordered both these factors may have dictated its size. If the missile were designed today it would probably have two or more stages, and be considerably smaller and lighter. On the other hand, its very size gives it particular value as a satellite launching vehicle.

The stainless steel structure of Blue Streak draws strongly on experience with Atlas, and has a pressure-stabilized liquid oxygen tank as on the U.S. missile. Its kerosene tank, however, appears to have external stringers and apparently does not rely on internal pressure for its rigidity.

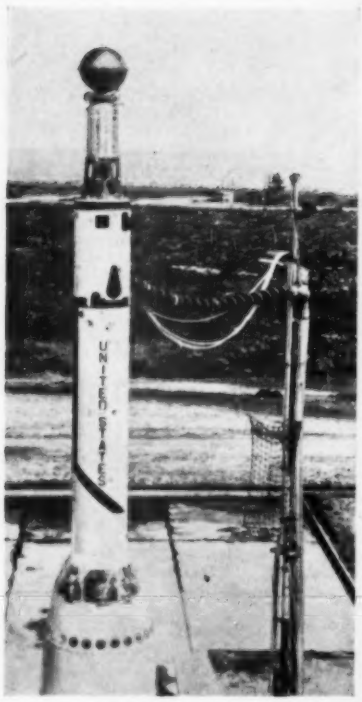
One feature of the missile system on which information has been given is its launcher, which is produced by Morfax, Ltd. (see THE AEROPLANE AND ASTRONAUTICS, May 27). This fabricated steel structure is mounted on a circular track and can be rotated, apparently for pre-launch alignment of the guidance system. The missile is held in position at its base by four articulated arms of a hydraulically operated release gear. For revolving the missile and launch platform, bogie units are jacked to engage with azimuth rails; they lift the platform feet clear of the ground. It can then be revolved to the required position and lowered before launching.

Several statements have been made about Blue Streak's ability as a satellite launcher. Most studies have coupled it with a Black Knight second stage. In this case it could put a 1,700-lb. satellite into orbit. Many facilities developed for proving the missile will retain their value if a space programme is adopted; in particular, the de Havilland test site at Hatfield, the engine test establishment at Spadeadam Waste in Cumberland, and the extension of the Woomera range in Australia.

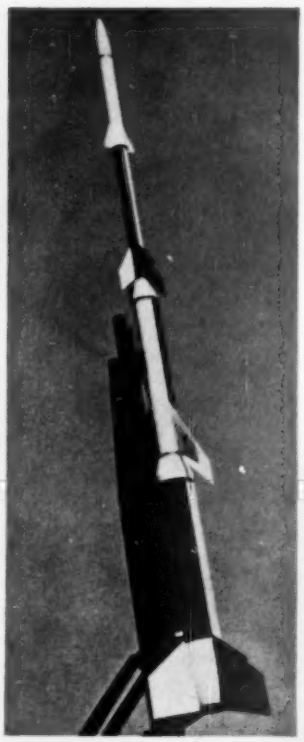

PAYLOAD VOLUME 53·4 CU. FT
NOSE CONE EJECTED IN TWO HALVES AT END OF FIRST STAGE
GROUND CONNECTIONS & RELEASE MECHANISM
KEROSENE TANK
H.T.P. TANK
TUBE THROUGH INNER TANK FOR ELECTRICAL & OTHER SERVICES
EXTERNAL FRAME WITH RELEASE MECHANISM & FAIRING
ELECTRICAL GROUND CONNECTIONS
SECOND STAGE PROBE SEPARATION
GROUND CONNECTORS FOR PROPELLANTS AND OTHER SERVICES H.T.P. SHOWN
WORKING PLATFORM
FINAL SEPARATION
SEPARATION LINE
OUTLINE OF BLACK KNIGHT/BLUESTREAK COMBINATION FOR COMPARISON
BLUE STREAK
POSSIBLE EXTENSION TO 'GAMMA' MOTORS
(SHOWN DOTTED)

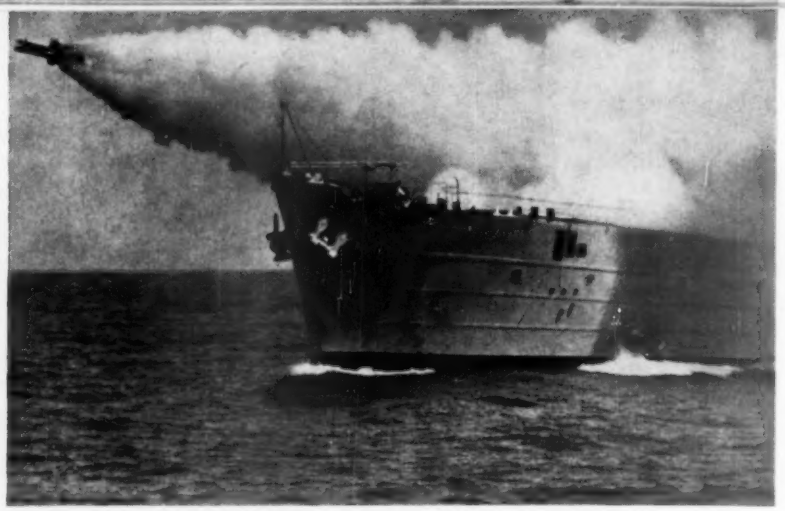
SATELLITE LAUNCHER.—Two possible versions of Blue Streak as a satellite launcher show it with an unmodified Black Knight as a second stage (right), and with a "compressed" Black Knight second stage (left).

Rocket Review



SPACE BALL.—Above, spherical container of the folded 100-ft.-dia. inflatable satellite poised on the nose of the three-stage Delta launching rocket which failed to enter orbit on May 13. A second launching is in preparation.

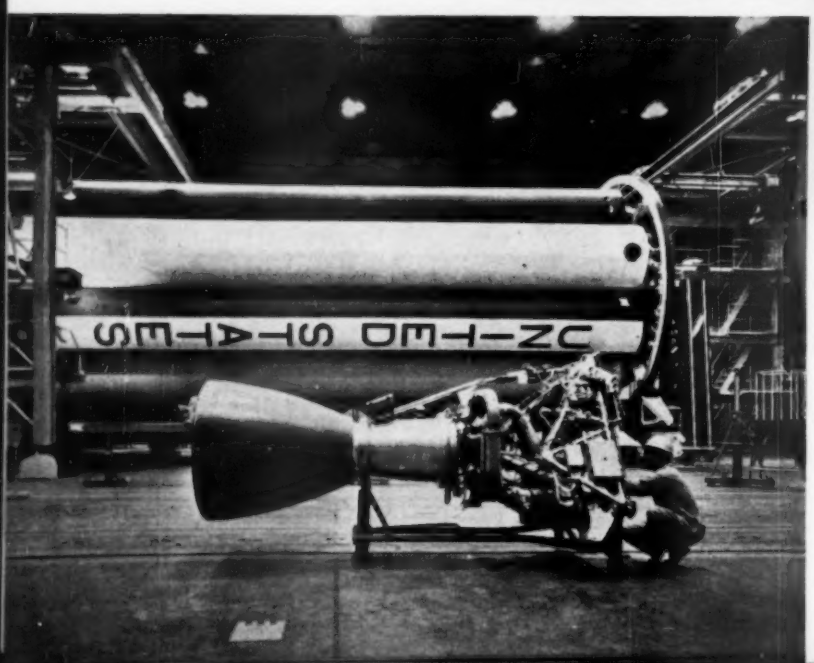




SEA PUNCH.—Above, two A.W.A. Seaslug surface-to-air missiles were launched from the missile trials ship, "Girdle Ness," during a recent demonstration off the coast of Malta. Both are said to have hit pilotless radio-controlled aircraft at a distance and altitude which rendered them invisible to the naked eye.

FRENCH FORAY.—Left, this four-stage research rocket was successfully launched from the Isle of Levant, near Toulon, France, to an altitude of 93 miles on May 5. Stage four, fired on the downward path, reached a maximum speed of 5,000 m.p.h. at an altitude of some 82,000 ft.

SPACESHIP.—Below, artist's impression of a multi-stage "lunar-reconnaissance" rocket designed by Krafft A. Ehricke of Convair-Astronautics. A single 1.5 million lb. s.t. engine and two 400,000 lb. s.t. engines in the first stage would employ liquid oxygen/kerosene; upper stages use lox-hydrogen. In the nose is a conical life-support system for the crew and a re-entry glider for returning to Earth.



BIG BOOST.—Left, first flight-test version of the Saturn booster of 1.5 million lb. s.t. is nearing completion at the Marshall Space Flight Center near Huntsville, Alabama. This picture shows the full-scale static test model with one of the eight Rocketdyne H-1 engines in the foreground; it developed a thrust of 1,500,000 lb. for 35 sec. on May 26.

Satellite Beacon

A UNIQUE experiment is soon to be attempted by the National Aeronautics and Space Administration in the shape of an artificial satellite which carries a flashing light. One of its major rôles will be to assist ground stations to obtain accurate measurements of the shape of the Earth and intercontinental distances. From perturbations in its orbital path, it is also hoped to determine variations in the Earth's crustal mass.

Weighing 150 lb., the satellite will embody solar cells for recharging chemical batteries, tracking transmitters, a command receiver, and optical "corner cubes" designed to reflect ground illumination by searchlights. Emitting 1-millisec. pulses of light every two minutes during night transits, the satellite should be visible to the naked eye at the prescribed orbital height of 800 to 1,000 miles with the brightness of a third- or fourth-magnitude star.

A large number of amateur tracking groups in various countries are expected to participate in the experiment, including the B.I.S. Moonwatch teams in the Isle of Wight, Bristol and Glasgow.

Space Observatory

ANOTHER interesting project which NASA has in the planning stage is a satellite "solar observatory" to be launched by a Delta rocket next spring. This will contain X-ray spectrographs sensitive to 10 Angströms, photomultipliers to detect ultra-violet, and instruments for several secondary experiments, including gamma radiation and neutron albedo.

It is proposed to employ momentum wheel and gas-jet orientation to keep the satellite pointed at the Sun with an accuracy of 1 minute of arc.

Ground-launched Target

A NUMBER of Ryan Q-2C target drones are being adapted for ground-launching to supplement present air-launching techniques (THE AEROPLANE AND ASTRONAUTICS, May 13, 1960). The first group of modified target planes will be used in a flight test programme at Hollomann Air Force Base, New Mexico, this summer.

When modified, the Q-2C will be capable of being launched from a parent aircraft or from the ground under rocket assistance using a 4-ft. "zero-length" launching rail. This, it is hoped, will provide a versatility of operation independent of weather conditions and other factors affecting the use of aircraft. After launching, a remote-control station on the ground will guide the Firebee to the desired altitude for the target run, and can command its recovery by parachute to a predestined area, permitting its repeated use.

In its programmes for air-to-air missile evaluation and aircrew training, the U.S.A.F. has been launching Firebees from modified B-26 bombers. Successful tests have recently been completed using the Lockheed GC-130 Hercules transport which can carry four Q-2Cs simultaneously, twice as many as the GB-26.

Underground Communications

NOVEL communications experiments are being conducted by the Boeing Airplane Company using "earth currents" rather than relay stations in space. According to Mr. L. A. Wood, general manager of the Aero-Space Division, the system is roughly comparable to radio transmission except that the antennae are buried underground. The aim is to eliminate the need for buried cables between command centres and weapon sites.

"Laboratory and experimental work to date has proved the feasibility of the system," Mr. Wood said. "When perfected, buried antennae will be almost impossible to destroy or sabotage and allow for a substantial reduction in cost compared with present-day communications networks."

Boeing are to continue tests at a special facility near Kent, Washington, south-east of Seattle. The company began working on "earth currents" more than 18 months ago. Development work is concerned with the design of buried antennae and special techniques employed for resistance to signal jamming. Most of the equipment can be purchased from available sources.

Tests have included transmission of signals from a deep mine shaft and reception of signals from the bottom of a lake. An experimental network was operated successfully for three months. However, the system is regarded as essentially short range and is unlikely to replace the artificial satellite as the global communications link of the future.

Missiles Afloat

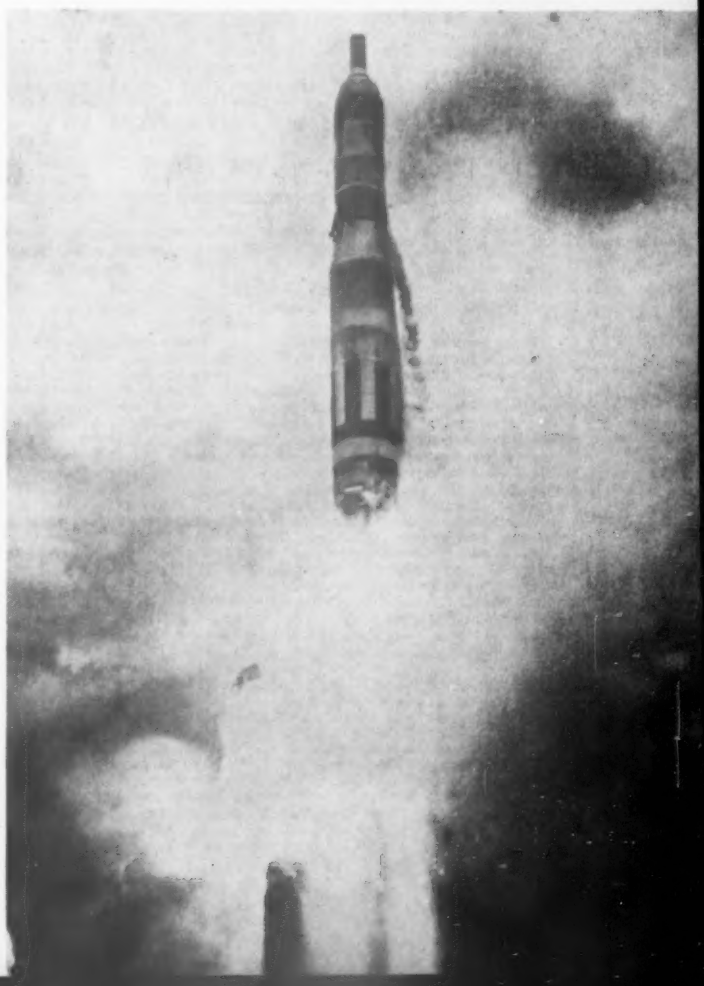
FIRST of the Royal Navy's guided-missile ships, H.M.S. "Devonshire," a county-class destroyer, is expected to join the Fleet in 1962. Armament will include one Seaslug guided-weapons system mounted on the quarter deck; four radar-controlled 4.5-in. guns forward and two Seacat close-range guided-weapons systems fitted abaft the after funnel.

For anti-submarine work, the ship will be fitted with the latest under-water detection equipment. She will also be equipped with the latest air and surface warning radars. An operations room of new design and electronic plotting facilities similar to those in the aircraft carriers "Victorious" and "Hermes" are being installed.

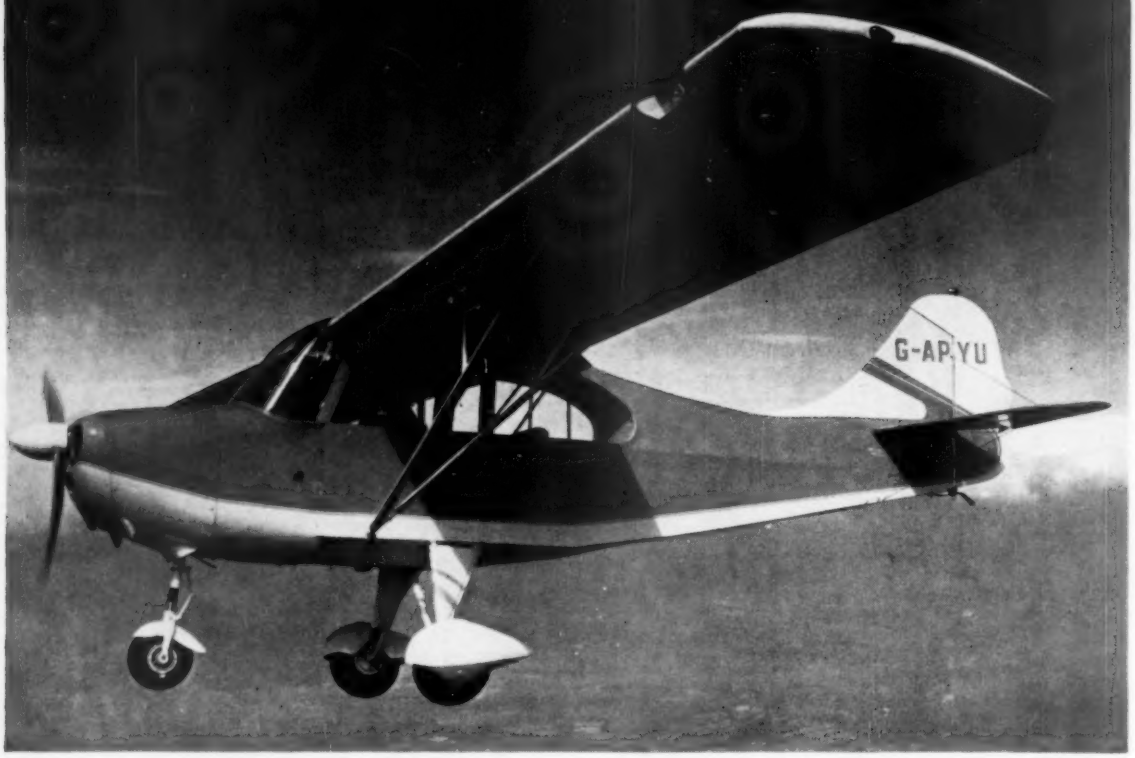
"Devonshire" will also carry a Westland Wessex helicopter, the first to be equipped as a complete "hunter-killer." Stabilizers have been fitted to the ship to facilitate helicopter operation in adverse weather.

Three more guided-missile destroyers are expected to join "Devonshire" by the spring of 1963—"Hampshire," "Kent" and "London." These ships will have three main rôles: first, they can operate as escorts for a task group, with the ability to provide guided-weapon anti-aircraft defence for the group and to augment its anti-submarine capability. Secondly, they can be used in offensive operations as part of light forces with the ability to bombard in support of land forces and to attack light forces with gunfire. Thirdly, they can perform police duties in peacetime in any part of the World.

"Devonshire" will be launched at Birkenhead today, Jne. 10.



HIGH HOPES.—Another successful test of a two-stage Titan ICBM took place at Cape Canaveral on May 27. This one, which projected its Avco nose-cone 5,000 miles, had been intended as a test for the Midas II IR missile-detection satellite but unfortunately the satellite suffered a communications failure and could not respond.



Photographs copyright "The Aeroplane and Astronautics"

Personal Flying

Flying a Pair of Two-seaters

by John Fricker

AMONG the many new light aircraft to reach this country in recent weeks were two two-seaters, one from Poland and the other from the U.S.A. Both have the 95-b.h.p. Continental C-90-12F flat-four engine but, apart from this feature and their common seating capacity, their design approaches are completely opposed within the mutual aims of touring and training.

Each type bears unmistakable evidence of its origin in all its features. The American Champion Tri-Traveler is a high-wing, strut-braced, tandem-seat design of mixed construction, with fabric covering and a steerable nosewheel landing gear, while the P.Z.L. 102B Kos has a metal cantilever low-wing airframe with side-by-side seating and a tailwheel undercarriage. Despite these many differences, and the 1,450-lb. gross weight of the Tri-Traveler compared with the 1,390 lb. of the Kos, general performances are almost identical although, in handling, the national divergencies again reveal themselves.

These became apparent when, at Biggin Hill a week or two ago, it became possible to fly both types alternately in succession several times during the same afternoon. They are both designed for aerobatics, including spinning for training duties. Pending full public transport validation of its C. of A., the installation of a shoulder harness, and one or two other minor mods., the comfortable Tri-Traveler is not yet cleared in this country for aerobatics, which were therefore not attempted. It apparently loops and stall-turns very nicely, although is not particularly light on the controls. On the other hand, the more sporting Kos, despite its classic European conception and more positive controls, did not entirely conform to conventional aerobatic handling standards, although proving equally pleasant for touring and general flying.

All this continues to prove that no manufacturer has yet succeeded in combining transatlantic standards of creature comforts with classic handling qualities and aerobatic capability. How far their respective designers have travelled towards this ideal may be judged from individual reports on the Tri-Traveler and the Kos.

CHAMPION MODEL 7FC TRI-TRAVELER

During World War II the Aeronca company built nearly 1,500 L-3 two-seat liaison aircraft for the U.S. Army, and subsequently developed from them the Model 7 Champion. Over 10,000 of the latter were sold between 1946 and 1951, production then ceasing until taken over in June, 1954, by the Champion Aircraft Corporation. The Champion was then produced as the Model 7EC Traveler, which was joined, in February, 1957, by the first nosewheel-geared Tri-Traveler.

Except for its revised undercarriage, the Tri-Traveler retains the basic simplicity of the original design, which is the cheapest American aircraft available in this country. The U.K. delivered price, including 17½% duty, is £2,950, through the agency of Mr. Edward Drewery, at Biggin Hill. Seven have so far been ordered for use as instructional aircraft, and there is considerable interest in their possible U.K. manufacture.

I was at Biggin when Mr. Drewery flew G-APYU up from Ramsgate, after assembly and shipment from America, and it was offered to me with just one hour on its recording tachometer. Sitting on its glassfibre-spatted undercarriage with its single large starboard door invitingly open, the perky little Tri-Traveler extended an appeal which was irresistible. Although cheap, it is very nicely built and finished, with Butyrate-doped fabric and a surprisingly high quality of cabin upholstery. Both seats are adjustable for leg length, and baggage space is provided in the rear cabin.

This is one of the most capacious of any two-seater and is wide and deep as well as long. Acres of window area, with sliding panels in front and rear, overcome most of the view penalties of the high-wing layout, although the dashboard seems unnecessarily high, particularly as it presents an imposing array of blankness in the standard aircraft. The Tri-Traveler arrives furnished with the essential minimum of instruments, including A.S.I. sensitive altimeter, tachometer and oil pressure and temperature gauges, and although there is ample provision for full IMC instrumentation and radio, this would impose quite a payload penalty.

Watch this space might well be the keynote of the comfortable Tri-Traveler cockpit, which has plenty of room for everything, including instruments, and is very simply equipped.

You are reminded of this by a dashboard notice which limits the fuel load to 17 Imp. gal. when two people are on board to keep within the gross weight, although the maximum capacity of the wing tanks is a useful 21.6 Imp. gal. The lower figure is still sufficient for more than four hours' range. There is a single rotary car-type fuel gauge in the starboard wing root, and an on-off cock on the port cockpit wall next to the ignition and carburetter heat levers. Despite its simplicity, the Tri-Traveler is completely fitted out for night-flying, with its electrical controls below the other wall panel.

There is very little else to the cockpit. Dual throttle knobs of a sensible size slide in flush quadrants on the port side, a similar control in the roof operates the elevator trim, and there are knobs and toggles on the front panel for cabin heat, engine priming and starting, and parking brakes.

One's legs feel almost lost in the vast space below the instrument panel (which has its few gauges on its flanks for back-seat observation when dual), but on locating the rudder pedals one finds inboard heel brakes to supplement nosewheel steering. Completing the simple array of controls are sensibly sized bowed sticks as a refreshing change from the almost universal American control wheel.

Attractive angularity characterizes the Champion Tri-Traveler.

No wonder, then, that the pre-flight briefing took little more than a minute before I was sent off to play with this attractive toy. In fact, the flight manual was not then available, so the operating speeds were anyone's guess in any case. A hefty pull on the starter handle brought the Continental into subdued life, and I was ready to try the ground manœuvrability of the Tri-Traveler on Biggin's broad tarmac area. Footloads for the steerable nosewheel are moderate, and a touch of heel brake will spin the aircraft round in little more than its own length.

Control is precise enough to tempt one into excessively fast taxi-ing, but one feels that the fuselage-mounted mainwheels may not be wide enough to cope with rapid turns in a strong cross-wind and still keep the Tri-Traveler on an even keel. It is certainly stable enough for all normal ground manœuvres, however, and the aircraft rides well, even on grass, without undue pitching.

Elevator control is sufficiently powerful to raise the nosewheel when taxi-ing at a brisk speed and, with full throttle and neutral trim, will fly the Tri-Traveler off with very little aft movement, solo, at 50-55 m.p.h. after a remarkably short run. I found that 70 m.p.h. gave a comfortable climb angle and a rate of ascent, on a rough calculation, of about 650 ft./min.

In the air, the Tri-Traveler has an atmosphere of comfort and confidence, and I found it great fun to fly. The controls require moderate forces to operate and are by no means brisk, but they are well co-ordinated and retain their effectiveness throughout the speed range. Although there was no turn and slip indicator, the seat of one's pants served as a reminder of a little aileron drag, necessitating the use of rudder to achieve an accurate turn—not a bad thing in a club trainer. At 2,300 r.p.m. the Tri-Traveler settled down to indicate something over 100 m.p.h. in cruising flight; if speed is increased towards Vne of 135 m.p.h., the controls heavy up noticeably. Normal fuel consumption is less than 4 g.p.h.

Positive lateral stability and the inertia of the high-aspect-ratio wing can be felt in the Tri-Traveler's fairly low rate of roll, but it can be wound up, with the assistance of rudder, to turn very tightly with lots of aft stick and to pivot on its inner wing tip. There are no flaps, so that longitudinal trim changes are confined to those with alterations of power. These, again, are moderately pronounced, but can be effectively cancelled by the roof trimmer.

In my first five minutes in the Tri-Traveler I had no hesitation in dicing round a few feet above Biggin's new control tower for some air-to-ground photography, and it was equally tractable when I took it up to 3,000 ft. for air-to-air pictures. I used the height to explore the low-speed characteristics, but I found that these could equally well be tried at a couple of hundred feet. On chopping power, a good strong pull is needed to keep the nose up, and the Tri-Traveler nods in and out of a straight, unheralded stall at 45-50 m.p.h. The total height loss is negligible.

With the extended fin, directional stability is very positive, but the Tri-Traveler can be side-slipped reasonably effectively to steepen the descent. Trimmed at about 65 m.p.h., the approach angle is not unduly flat, despite the absence of flaps, while the threshold speed can be further reduced and still achieve a nice flare-out. Elevator control remains precise for a smooth mainwheel touch-down, and as soon as the nosewheel is lowered steering and braking are available for a very brief landing run. Like the rest of its operation, landing the Tri-Traveler is ridiculously easy but, curiously enough, is not unsatisfying.

Perhaps because of its " back-to-basics " atmosphere, I thoroughly enjoyed flying G-APYU, and I think it is a promising trainer for the new (to this country) generation of light personal and business aeroplanes—a sort of modern Tiger Moth—as well as a good low-priced tourer in its own right. Not being an instructor, I cannot assess the suitability of the rear seat from that aspect, but thousands of pilots have been trained on Cubs with a similar layout.

Dimensions.—Span, 35 ft. 2 in.; length, 21 ft. 6 in.; height, 8 ft. 8 in.; wing area, 170.2 sq. ft.
Weights.—Empty, 968 lb.; loaded, 1,450 lb.
Performance.—Cruising speed, 108 m.p.h.; initial climb, 648 ft./min.; service ceiling, 12,000 ft.; stalling speed, 52.5 m.p.h.; take-off run, 650 ft.; landing run, 440 ft.; range, 560 miles.

P.Z.L. 102B KOS

This little aeroplane started life in Warsaw in 1957 and the prototype, with a 65-b.h.p. Narkiewicz engine, first flew on May 21, 1958. The P.Z.L. 102B was subsequently developed to take the 95-b.h.p. Continental, and about 20 production aircraft have since been exported to such countries as Brazil, the Lebanon and Finland for training or touring use. The Kos was designed to the B.C.A.R. semi-aerobatic load factors of +4.5 and −2.25 *g*, and is available with either dual wheel or stick control, according to requirements.

SP-PAM, which arrived at Biggin Hill towards the end of May for a brief sales tour through the agency of Norco Engineering, Ltd., of Burgess Hill, had twin joysticks in its cockpit, with blanking plates on the instrument panel for the handwheel shafts. Its business-like lines are moulded in metal with fabric covering used only on the wings, aft of the main spar and for the control surfaces. Fuel is in a 16.5-Imp.-gal. fuselage centre-section tank.

A rapid ground survey of the Kos revealed several interesting engineering features, including a well-designed clamshell engine cowling for rapid access and powerplant maintenance. The very large sliding bubble canopy also seemed quite an engineering achievement, although its moulding showed signs of optical aberration.

It could be locked open in several positions and gave easy access to the very wide cockpit. Ample shoulder room has been provided in the Kos, at the expense of a very broad front fuselage and canopy, which may have given rise to some slightly odd aerodynamics. The result is a commendable amount of room, however, and there can be no criticism of the magnificent all-round view except, possibly, over the flat-topped cowling when taxi-ing.

Looking to each side, the stubby wings hold promise of a brisk and potent lateral control, which is also foretold by the small stick movement needed to move the ailerons through their range of travel. In its furnishings, the Kos is typically East European and reminded me of my flights in Russia. The tiny two-needle tachometer at the bottom of the small central panel, with its metric basic instruments, was undoubtedly of Soviet origin. It was, perhaps, unfortunate that a demonstrator for the U.K. could not have been equipped with Western-type instrumentation and cockpit lettering.

Barrel-shaped handles proved to be controls for carburetter and cabin heat, and the Kos had the usual starting and priming levers, plus switches for night-flying equipment and radio. A large Polish VHF set was mounted beneath the centre panel, but was not used.

Dual rudder pedals had toe straps for inverted flight, were adjustable for leg length, and the port set was provided with toe brakes. I could not discover a parking-brake catch. The remaining controls comprised duplicated throttle and mixture knobs on each cockpit wall and a large handwheel between the seats, as in the Messenger/Gemini, for the split flaps.

Unfortunately, unlike the Miles aircraft, the Kos does not have its elevator trim actuated by a similar wheel, but by a minute knob on the dashboard. This is remarkable as much for its insensitivity and difficulty of operation as for its smallness and illogicality, and seemed to me a rather unhappy affair altogether.

In keeping with its more sporting conception, which was also illustrated by the Sutton-type harnesses, the Kos proved rather noisier than the similarly powered Champion, and the level of vibration was also noticeably higher. When taxi-ing and in flight, some degree of CO_2 contamination was evident. The throttle proved very sensitive to small degrees of movement over the initial part of its working range but, despite the absence of a steerable tailwheel, taxi-ing was quite simple, and the toe brakes could be freely applied without any tendency to raise the tail.

On grass, the oleo-pneumatic undercarriage seemed rather hard.

Personal Flying . . . .

A truly Continental atmosphere is conveyed by the cockpit of the P.Z.L. Kos, which in its training version is equipped with dual control column instead of hand-wheels. Blanking plates for the latter may be seen on the instrument panel below.

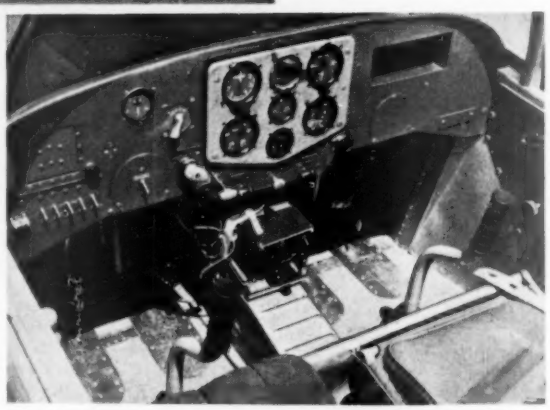
Photographs copyright "The Aeroplane and Astronautics"

if the airframe rattle was any indication. On take-off with flap lowered to a red mark on the wing quadrant, the Kos tended to swing to the left, nearly full right rudder being required in the early stages of the run, despite substantial fin offset. The paddle-bladed wooden airscrew of the Kos is of noticeably coarse pitch and, whereas the Continental develops its 95 b.h.p. at 2,625 r.p.m., the little tachometer did not indicate more than 2,250 r.p.m. during take-off and climb. Nevertheless, acceleration was quite brisk and the take-off run was commendably short.

Solo, the V.S.I. indicated nearly 4 m./sec. rate of climb at 120 km./hr. or, in English, more than 750 ft./min. at 74.5 m.p.h. One's first airborne impressions of the Kos are confirmation of its lateral sensitivity, with finger-tip aileron application and barely neutral stability, contrasting fairly pronouncedly with a heavy-ish elevator and positive fore-and-aft stability. There is something slightly artificial in the elevator feel, which is hardly surprising when one finds a substantial T-section strip on each of the trailing edges. This would have the effect of heavying them up, which may have been thought necessary, but seems to have been overdone.

The rudder is more in harmony with the ailerons, being rather light and quite effective at cruising speeds, although directional stability is just about positive. Initial movement of the ailerons feels rather like powered controls, with low "break-out" forces and a crisp response, but the effort required for increased deflections goes up fairly noticeably. The Kos proved quite pleasant to fly, however, at the selected power of 2,300 r.p.m., which returned a fraction over 170 km./hr., or some 106 m.p.h. This tied up well with the manufacturer's claim of 108 m.p.h. at 2,350 r.p.m. (68 b.h.p.), when the fuel consumption is said to be 3.8 gal./hr.

So far as aerobatics were concerned, I did not try more than a loop or two, starting from a diving speed of 200 km./hr. (124 m.p.h.). The coarse-pitch prop. kept the revs. down to well below the maximum 2,625, and I pulled the Kos up into a fairly gentle loop pulling not more than about 3 *g*. About three-quarters of the way up there was an unaccountable corkscrew tendency as one wing dropped, and the Kos went over the top rather untidily, although unstalled. This happened to other British pilots when trying a similar manœuvre, and to achieve a straight loop it seems necessary to fly the Kos determinedly round at about 4 *g*. There seems little likelihood of exceeding the speed limit of 187 m.p.h.



In plan view, the P.Z.L. Kos displays its very flat front fuselage resulting from the wide cockpit. End-plate "fences" may just be discerned on the tailplane.

At the low-speed end, the Kos handles quite well, with an innocuous clean stall, after a slight and brief elevator buffet from the wing-root knife-edges, at about 90 km./hr. (56 m.p.h.). With full flap and power (extension being accompanied by a very mild trim change), the Kos stalls at about 75 km./hr. (46 m.p.h.), and there is a mild port-wing drop. There seems to be no tendency to spin and provocation at the stall results only in a spiral dive.

In the circuit, the flaps are fairly effective in steepening the glide, but full anti-clockwise rotation of the trimming knob still leaves a small-residual nose-down load for the final approach. The trimmed gliding speed, with full flap, of about 125 km./hr. (77 m.p.h.) is quite comfortable, however, for a pre-threshold approach and allows a slightly prolonged flareout. This is desirable because the Kos requires to be flattened out fairly low, since it tends to touch down rather decisively slightly before one assumes the three-point attitude has been reached.

Once down, however, it shows no tendency to bounce, although from the fuselage-mounted undercarriage one gets the impression that careful attention on the rudder is needed to keep straight during the brief landing run. After flying the Kos one must conclude that, at its U.K. price of £2,465, it is unrivalled by any other all-metal two-seater of comparable size, particularly since its accompanying spares inventory is most impressive, but there are a few detailed points in its design capable of further development.

DIMENSIONS.—Span, 27 ft. 9 in.; length, 22 ft. 10 in.; height, 6 ft. 2 in.; wing area, 119 sq. ft.

WEIGHTS.—Empty, 890 lb.; fuel (15.5 Imp. gal.), 115 lb.; oil (1.1 Imp. gal.), 11 lb.; crew, 339 lb.; baggage, 35 lb.; max. gross, 1,390 lb.

PERFORMANCE.—Max. speed, 120 m.p.h.; cruising speed, 108 m.p.h.; initial climb, 810 ft./min.; service ceiling, 15,000 ft.; climb to ceiling, 47½ min.; stalling speed, flaps down, 48 m.p.h.; take-off to 50 ft. (gross), 1,300 ft.; landing from 50 ft., 1,100 ft.; range at 102 m.p.h., 400 miles; endurance, 4 hr. 15 min.

Correspondence

From A.V.M. Sir Ranald Macfarlane Reid, K.C.B., D.S.O., M.C.

"Take the piston rod . . ."

I WOULD be most grateful if you could tell me where I can find the words of the old R.F.C. song: "When the Court of Inquiry assembles to find out the reason I died, You can say I forgot 2×Iota was the minimum angle of glide," etc., etc., with chorus "Take the piston rod out of my kidneys, the connecting rod out of my brain, my brain. From the sole of my feet take the cylinders and assemble the engine again," etc., etc. I think THE AEROPLANE published it years ago.

We sang it last New Year's Eve with several R.F.C. present at Norman Brearleys (ex Gosport and Smith Barry), to the tune of "Tarpaulin Jacket." We hope to sing it again next year correctly.

Peppermint Grove, Western Australia. RANALD MACFARLANE REID.

The Linnet's Fuel Cock

I REFER to Mr. Gilbert's interesting article on the Royal Aero Club's touring competition.

For safety reasons, I would not like to fly an aeroplane which has no fuel cock, and I can assure Mr. Gilbert that the Linnet has one fitted in a prominent position—labelled too!

The fact that I did not have to turn it on in order to start the engine is another matter.

Buckingham Palace. JOHN SEVERNE (Sqn. Ldr., R.A.F.).

Cost of Caribbean Flying

REFERENCE is made to your announcement in THE AEROPLANE AND ASTRONAUTICS for May 27 last (p. 661) in which you stated a figure for the operation of American light aeroplanes hired from Rent-a-Plane, Ltd.

We would like to point out that although your basic figure is correct, namely £6 15s. 3d. and £4 19s. respectively for the Caribbean and Super Cub aircraft, the assumption that flying clubs could operate at a considerably lower figure is entirely erroneous. Surely the staff of flying clubs have to be paid, and these salaries must be obtained from the aircraft operations? On a 200-hour utilization basis, at least £1 per hour would have to be added by the clubs in order to cover the instructors' salaries alone. For those clubs unfortunate enough to have to pay rent for their premises, the amount per hour over and above your figure would probably have to be more.

At Oxford we are already operating a new Caribbean. This aircraft is not on hire from Rent-a-Plane. We have taken considerable trouble to price our aircraft fairly, and we find that in order to operate economically £7 per hour is the cheapest at which we can provide modern flying for our members.

Kidlington, Oxon. R. A. Smith (Chief Flying Instructor).

[As we computed these figures for the equal benefit of clubs and private owners they naturally referred only to the basic operating costs. It was to these that we referred the possibility of reduction through the petrol tax rebate: we are grateful to Mr. Smith for informing us of the addition to be expected for club operation.—ED.]

PROBYN'S PUSHER.—From Nairobi has come this photograph of a Grunau Baby which its owner built and then modified to take a Volkswagen engine. The pilot, and owner, once well known for his activity in private flying in this country, is Air Cdre. H. M. Probyn, C.B., C.B.E., D.S.O. (Retd.). A correspondent has asked whether such aircraft fly in England.

Aroundabout

Look Out. Will Canadair set a trend with the enlarged windscreen area of their production CL-44s? Or will airliner crews still be satisfied with a look-out as limited as a submarine's? Perhaps they just don't want to *see* what is about to hit them?

*

SOS—Same Old Stuff. A friend brings back this story from America: Arriving over an airport, a jet-liner's passengers were told by the cabin address speakers, "Ladies and gentlemen, I have to tell you that our undercarriage has failed to come down. However, the runway has been covered with foam, emergency services are standing by and every precaution taken for a safe landing. Please fasten your seat belts tightly and carry out the cabin staff's instructions. This announcement has been recorded."

*

Canadian Collection. In Canada a farmer-mechanic has a collection of 48 last-war aircraft—Swordfish, Albacore, Lysander, Yale—and a reserve stockpile of engines and propellers. As a Canadian paper says, "Rangy Ernie Simmons is better equipped for a war than Canada was in 1939." But Ernie is no Shuttleworth. He's only in business for the money he hopes to make out of selling the bits of his sadly dilapidated fleet.

*

I wish I could have got along to the Whit-Monday display at White Waltham. According to their publicity stickers, this is what I missed.

by Graham

Industry Record

New Filters and Bellows

Two new products were exhibited at a recent display in London by the Vokes Group. These were Poroloy all-metal filters and Genflex bellows expansion joints; the new filters are particularly suitable for high-pressure hydraulic, servo and fuel systems.

The filter elements are manufactured by Vokes under licence from the Bendix Aviation Corp. of the U.S.—the Poroloy technique having been developed by the California Institute of Technology. The elements are available in two types, Poroloy CM and Poroloy T.

Poroloy CM is made by sintering woven wire cloth or mesh. A wide variety of pore sizes can be produced, and several layers of the material can be sinter-bonded together to increase thickness and improve rigidity. The material is available in thin flat sheets and can easily be corrugated to give maximum filter area. Large flat sheets can be used for boundary-layer control applications; ultimate tensile strengths vary from 2,000 to 60,000 lb./sq. in.

Nominal pore-size ratings can vary from 2 to 1,000 microns. Almost any metal that can be drawn into fine wire can be made up into Poroloy CM. As the filter is made of continuous wire strands bonded at each contact point, it is claimed there is no possibility of particles becoming detached to enter the filtrate.

Poroloy T has similar properties to Poroloy CM, but it is made by winding fine flattened wire on to a mandrel. Precision machines position the wire to produce the desired pore size and configuration. Wall thickness and density are controlled by varying the number of layers. The crossing wires are bonded at each point of contact by sintering in a controlled-atmosphere furnace. Flat sheets, seamless tubing and tapered seamless tubing are available in this material; ultimate tensile strengths vary from 5,000 to 100,000 lb./sq. in. and nominal pore sizes from 5 to 1,000 microns.

The bellows expansion joints are produced by Vokes Genspring, Ltd. They are made from cold rolled sheet which is longitudinally butt-welded under controlled conditions to form a tube. Convolutions are formed on machines designed and built in the Vokes Group.

Standard expansion joints are offered in bores between 3 in. and 120 in. They are normally produced in 18/8 stainless steel, but can also be manufactured, to special order, in other materials such as Monel, titanium, Inconel and the Nimonic range of alloys. Rectangular and other special bellows can also be made, and bores above 120 in. can be produced.

Aeronautical Computer Training

The College of Aeronautics, Cranfield, has placed an order with Ferranti, Ltd., for a Pegasus digital computer, delivery of which is scheduled for July of this year. It will be used to teach students the fundamentals of programming and computer techniques, a study of which is already included in the College's curriculum. It will be operated by the Department of Mathematics for the benefit of the departments covering aerodynamics, design, economics and production, electrical engineering, flight, materials, and propulsion, and will extend considerably the scope of research at the College.

In addition to solving scientific problems, the computer, in conjunction with automatic recording equipment, will form an important link in wind-tunnel, engine, and flight test chains. It will also be used in investigations into stock-control and accountancy; and looking into the future, the digital computer may also be employed in research on information retrieval systems.

PUBLICATIONS RECEIVED

ABC Russian Aircraft. — The second edition of this title in the Ian Allan series, with photographs, silhouettes and details of all current Soviet military and civil aircraft. By John W. R. Taylor. 32 pp. 7¼ in. by 9¼ in. Illustrated. Ian Allan Ltd. Price 2s. 6d.

The Aerodynamics of Powered Flight.—A new American textbook for the undergraduate or for self-study, including 216 problems. By Robert L. Carroll. 286 pp.: 6 in. by 9¼ in. Illustrated. John Wiley and Sons, Inc. Price 68s.

The interior of the General Precision Systems caravan now in Europe demonstrating their single seat Link Trainer equipped with a four station radio aids unit. This unit provides the means for simulating automatically all the up-to-date radio navigation facilities.

Aviation Calendar

Jne. 10

London.—R.Ae.S. Rotorcraft Section lecture, "Helicopter Vibration," by Dr. J. P. Jones, in the Library, 4 Hamilton Place, W.1, at 18.00 hrs.

Cranfield.—College of Aeronautics Open Day; and Jne. 11.

Jne. 18

Angers.—14th International Wine Rally. "*Fleurs et Châteaux d'Anjou.*" organized by the West Aero Club of France.

Jne. 20

Athens.—NATO AGARD Ionospheric Research Committee Meeting, "Radio Wave Absorption"; until Jne. 23.

Jne. 25

Staverton Aerodrome.—Air Show, organized by Cheltenham and Gloucester R.A.F. Association, at 15.00 hrs.

Escoublac, la Baule.—Invitation Air Rally for Members and Associate Members of the Royal Aero Club; until Jne. 27.

Jne. 28

London.—Guild of Air Pilots and Air Navigators presentation of Meteorological Office Awards, at 14 South Street, Park Lane, W.1., at 16.00 hrs.

Jly. 2

St. Gatien, Deauville.—Invitation Air Rally for Members and Associate Members of the Royal Aero Club; until Jly. 4.

Jly. 4

Harrogate.—British Computer Society Conference, in the Sun Pavilion.

Jly. 8

Baginton, Coventry.—Lockheed International Aerobatic and King's Cup Air Race, organized by the Royal Aero Club; and Jly. 9.

New Patents

APPLICATIONS ACCEPTED

841,852.—**Link Aviation Inc.**—"Navigation training apparatus."—Aug. 24, 1956. (Aus. 24, 1955.)

841,943.—**M.L. Aviation Co., Ltd.**—"Aircraft fuselages."—Feb. 26, 1957. (Mar. 14, 1956.)

841,580.—**Boeing Airplane Co.**—"Jet propulsion engine with noise suppression nozzle means."—Jan. 29, 1957. (Feb. 7, 1956.)

Printed specifications of the above will be available on Jly. 20, 1960, and the opposition period will expire on Oct. 20, 1960.

Company Notices

NEW COMPANIES

Rent-a-Plane, Ltd. (658,742).—Private co. Reg. May 10. Cap. £1,000 in £1 shs. Purchase or hire aircraft of any type. Directors: John N. Christopherson, 28 Dukes Lodge, 80 Holland Park, W.11, and Robert O. Camac, 25a Markham Street, S.W.3. Sec.: Robert O. Camac. Sols.: Ranken, Ford and Chester, W.C.1. Reg. off. 40/42 Copthall Avenue, London, E.C.2.

W. A. Parker (Aircraft Spares), Ltd. (659,111).—Private co. Reg. May 13. Cap. £1,000 in £1 shs. Acquiring the business of aircraft spares and job stock dealers now carried on by William A. Parker, at 77 Sewardstone Road, Chingford. Directors: William A. Parker, 50 Stonards Hill, Loughton, Essex; Doreen V. Parker, 50 Stonards Hill, Loughton, Essex; Kathleen P. Wilson, 218 Sinclair Road, Chingford. Sec.: Doreen V. Parker. Reg. off.: 77 Sewardstone Road, Chingford, E.4.

Personal Notices

BIRTHS

Broadfoot.—On May 25, at Louise Margaret Hospital, Aldershot, to Kathleen (*née* Telford), wife of Flg. Off. R. K. Broadfoot—a daughter.

Corderey.—On May 26, at the R.A.F. Hospital, Ely, to Pat (*née* Stephens), wife of Flt. Lt. Ivor Corderey—a son.

Plenderleith.—On May 13, at the Louth and District Hospital, to Peggy, wife of Sqn. Ldr. B. W. Plenderleith, M.A., R.A.F.—a daughter.

Riall.—On May 29, at R.A.F. Hospital, Ely, to Pam, wife of Gp. Capt. A. B. Riall—a daughter.

Ridpath.—On May 23, to Billie, wife of Flt. Lt. F. T. Ridpath—a daughter.

Rowe.—On May 27, at R.A.F. Syerston, to Sheila (*née* Martin), wife of Flt. Lt. David Rowe—a son.

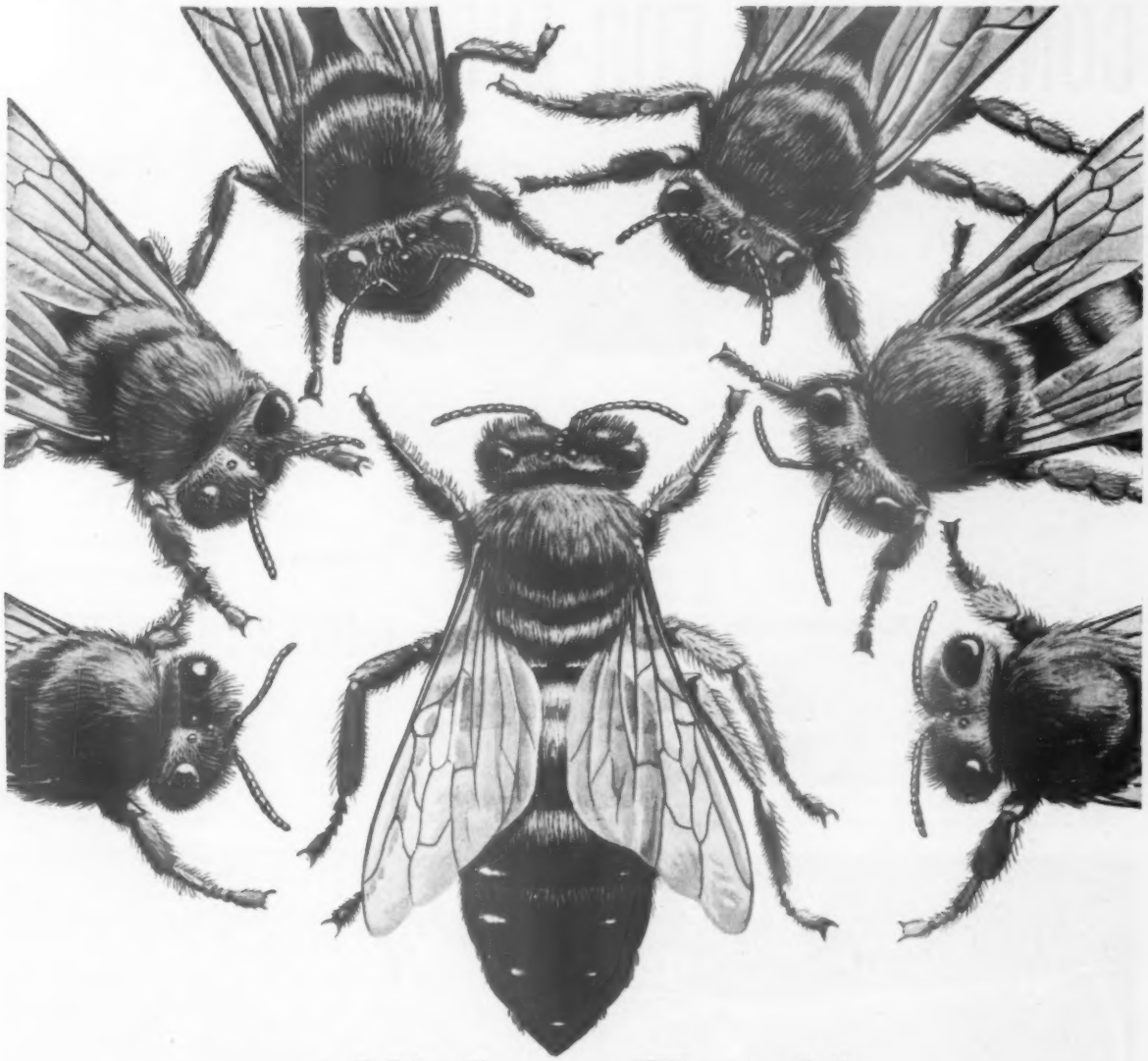
Walton.—On May 30, to Pamela, wife of Sqn. Ldr. H. R. Walton—a daughter.

Wasley.—On May 21, at R.A.F. Hospital, Wegberg, B.F.P.O. 40, to Gwyneth (*née* Parsons), wife of Flt. Lt. R. J. Wasley—twin daughters.

DEATHS

Brown.—On May 4, at R.A.F. Honington, Flt. Lt. John Anthony Brown, A.F.C., R.A.F.

Thornally.—On May 30, Flt. Lt. G. B. Thornally.



x Minds 1 Thought

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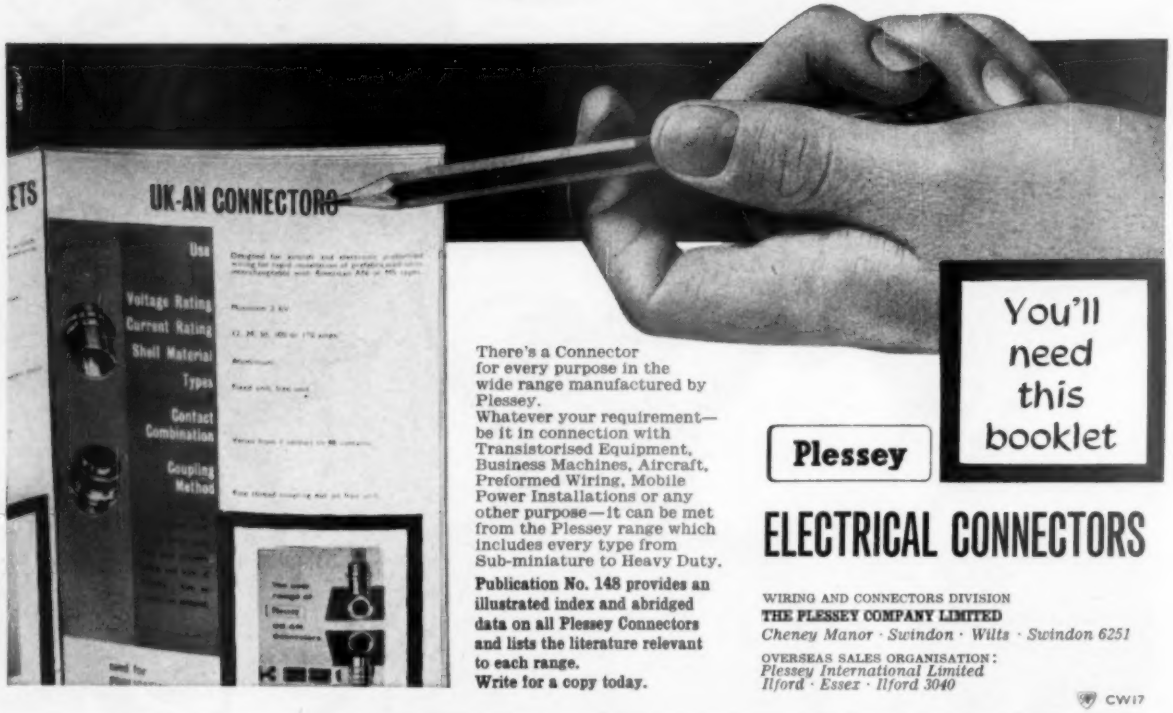

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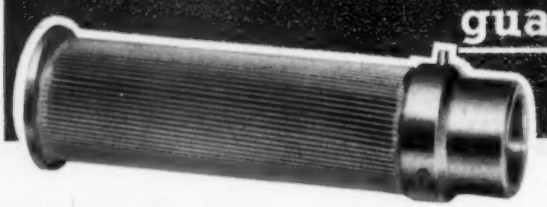

... widely used in American aircraft and missile programme

POROLOY CM.

Vokes now introduce a new all metal filter medium of outstanding efficiency for the *controlled* filtration of hydraulic and lubricating oils, fuels, air, gases, acids, caustics and related caustic materials, chemicals and solvents at extreme temperatures and pressures. Poroloy CM filter elements can be made in any size or shape from a variety of metals—Stainless Steel, Inconel, Nickel, Copper, Steel and Nichrome being the most popular—features which, combined with special production techniques to give controlled pore configuration, enable filters to be individually designed for special applications. Metals can be selected with the particular requirements of the application in mind and the size of the pores can be controlled to deal with particles of between 2 and 250 microns. Poroloy CM filters are therefore 100% effective against a stated particle size, *the danger of media migration being eliminated by an accurately controlled sintering process.* The ultimate tensile strength of the elements varies from 2,000 to 60,000 p.s.i. and the operating temperature range is from −400°F to 1200°F.

The unique combination of properties found in Poroloy CM has led to its recent use in critical temperature conditions in the United States missile and aircraft industries, including installation in the Boeing 707.

POROLOY T.

Similar in performance to Poroloy CM but manufactured by a different process, Poroloy T has an operating temperature range from −400°F to 1500°F. Pore size ratings are from 2 to 250 microns and tensile strength varies from 2,000 to 100,000 p.s.i.

This illustration shows the many sizes and forms—seamless tubes, flat discs, corrugated elements etc.—in which Poroloy can be manufactured.

Both filter elements are manufactured in conditions of micro-cleanliness and before despatch are individually checked for performance in bubble point testing equipment.

Poroloy was developed by the California Institute of Technology and is manufactured in the U.K. under license from the Bendix Aviation Corporation, U.S.A.

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FOR example we have already sold five Piper Apaches, two new ones and three used ones. We were also responsible for the sale of several Cessnas and two Piaggio 166s, the last one to the Earl of Derby.

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Inclusion of Dusseldorf as an alternative to Frankfurt on Reserved Routes No. 1, 2, 4, 5, 6, 7, 8, 10, 11 and 12, from September 10, 1960 (Application No. 201).

Inclusion of Mafraq (or Amman) and Baghdad as additional or alternative traffic stops to Beirut or Damascus on Reserved Route No. 10 and for the option to terminate the service at Bahrein or Kuwait, from October 9, 1960 (Application No. 210).

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.
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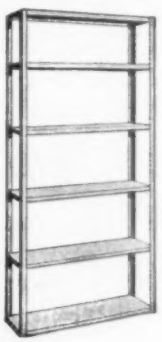
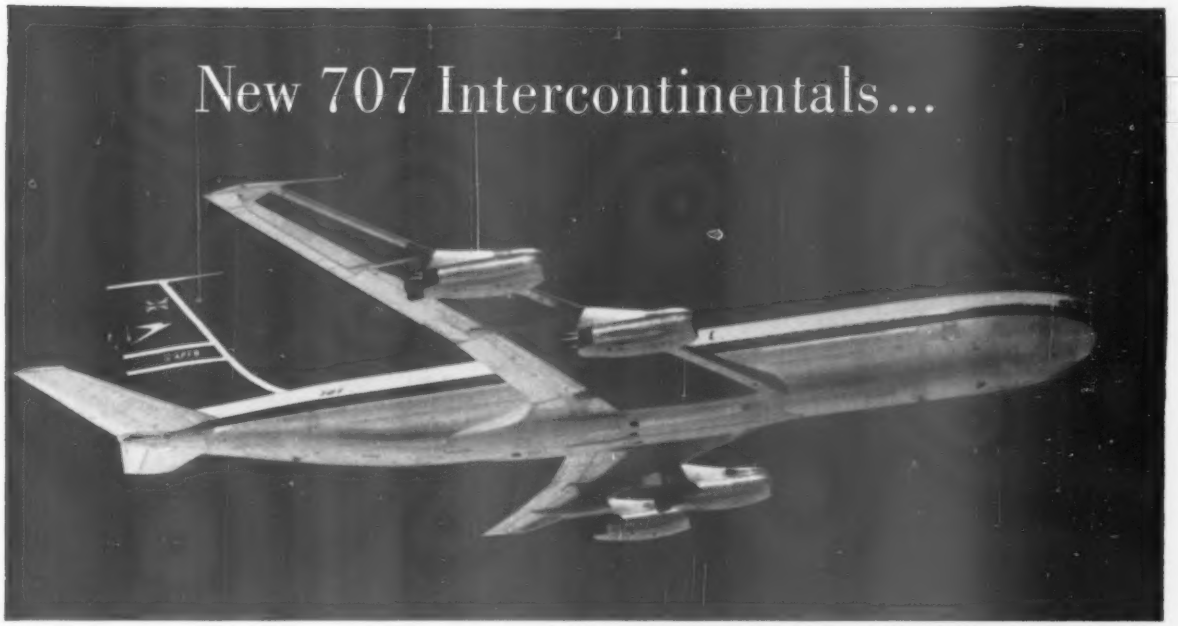


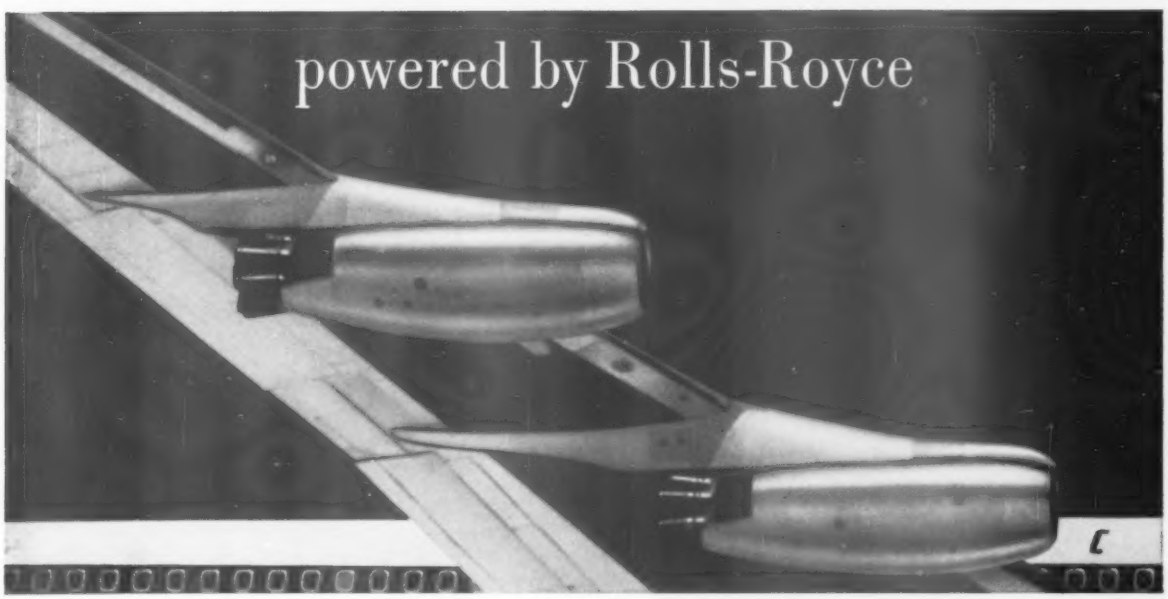
INDEX TO ADVERTISERS

Name	Page
A	
Aero-Enterprises (Boreham Wood), Ltd.	29
Airwork, Ltd.	31, 32
B	
Blackburn Engines, Ltd.	25
Boeing Airplane, Co.	Inside Back Cover
B.P. Aviation Services	27
British Aircraft Corporation	18, 19
British European Airways	4
British Oxygen Aviation Services	24
British United Airways	30
B.S.T. Aeronautical Ltd.	30
C	
CIBA (A.R.L.) Ltd.	1
Commonwealth of Australia	31
Cross Manufacturing Co. (1938), Ltd.	30, 31
D	
Dowty Rotol, Ltd.	13
Dundas, R. K., Ltd.	29
Dunlop Rubber Co., Ltd.	21
E	
English Electric Co., Ltd., The (Guided Weapons Division)	26
F	
Fireproof Tanks, Ltd.	14
Fletcher, C. W., & Sons Ltd.	14
G	
Garrett Corporation, The	6
Godfrey, Sir George, & Ptnrs., Ltd.	8
G.Q. Parachute Co., Ltd.	22
H	
Hall & Hall, Ltd.	8
Hawker Siddeley Aviation, Ltd.	Front Cover, 31
Hobson, H. M., Ltd.	15
Hunting Aircraft, Ltd.	23
Hymatic Engineering Co., Ltd.	12
L	
Lockheed Precision Products, Ltd.	Inside Front Cover
M	
Ministry of Aviation	30
Mole, Group Captain Edward	30
N	
Nord-Aviation	5
P	
Plessey Co., Ltd., The	28
Power Auxiliaries, Ltd.	7
R	
R.F.D. Co., Ltd.	9
Rochdale Metal Products, Ltd.	32
Rolls-Royce, Ltd.	16
Rotax, Ltd.	20
Rye, Claude, Bearings	31
S	
Shell Aviation Services	Back Cover
Short Brothers & Harland, Ltd.	10, 11
Smiths Aviation Division	2, 3
V	
Venner Accumulators, Ltd.	14
Vickers-Armstrongs (Aircraft), Ltd.	17
Vigors Aviation, Ltd.	29
Vokes, Ltd.	28

Printed in England and Published Weekly by the Proprietors, TEMPLE PRESS LIMITED, BOWLING GREEN LANE, LONDON, E.C.1.
Registered at the G.P.O. as a Newspaper. Second class postage paid at New York, N.Y.

AGENTS ABROAD—EUROPE—Messageries Dawson (S.A.), Paris; Messageries Hachette, et Cie, Paris; W. H. Smith & Son, Paris and Brussels. CANADA—Wm. Dawson Subscription Service Ltd., Toronto; Gordon & Gotch Ltd., Toronto. U.S.A.—Eastern News Co., 306 West 11th Street, New York, 14, N.Y. AFRICA—Central News Agency, Ltd., Cape Town; W. Dawson & Son (S.A.), Cape Town. ASIA—W. Thacker & Co., Ltd., P.O. 100 Bombay. AUSTRALIA and NEW ZEALAND—Gordon & Gotch (A'sia), Ltd.





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Istanbul is a divided city, split into two by the unpredictable waters of the Bosphorus. On the western shore lies Yesilkoy airport, important fuelling point for international airlines. On the other side, at Beykoz, is the Shell installation from which aviation fuel has constantly to be fed across the Straits by barge.

Just an ordinary ferrying operation? Far from it. The Bosphorus is no ordinary waterway. Into it flows escape water from the Black Sea, swollen by torrents from the mighty rivers Danube, Don, Dniester and Dnieper. It is seldom calm and in places the current reaches 6 knots. Beneath steep, craggy banks the water swirls, at times being whipped into fury by the "Lodos" wind which troubles even the largest ocean-going vessels and makes tying up to the jetties with a cargo of inflammable spirit a precarious job.

There are other hazards. Dense fog in spring and autumn can bring shipping to a halt, and in winter icefloes can make navigation a nightmare. The Bosphorus, too, is a vital waterway and is often thronged with traffic — 18,000-ton tankers; heavy men-of-war; the ubiquitous caiques and fishing boats. Through them all, as normal routine, the Shell barge threads its way to and fro every day, carrying the supplies which are life-blood to the international airline operators.

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